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May 1958

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Save MONEY, TIME and LABOR-

GALION 503 Grader with VIBRATORY COMPACTOR

GRADE AND COMPACT WITH SAME MACHINE!

This combination of 503 Grader and Jackson Vibratory Compactor does the work of two basic machines—thereby reducing equipment investment. There is no interference with ordinary grader operations such as spreading and leveling. However, the compactor is easily removed to permit full grader operations.

The vibratory compactor will accomplish most specified densities (including Proctor, Modified Proctor, and AASHO-T99-49) often in ONE pass.

With this combination you save . . . on equipment, labor, operating and overhead costs.

HIGH-SPEED MOBILITY—on the job and between jobs!

Compactor is easily raised or lowered by hydraulic power controlled from operator's platform. Permits the high speed of the grader to be utilized for maneuvering and dead-heading on the job and traveling between jobs. Saves time, permits more work to be done per day.

PROVIDES MULTI-PURPOSE USE!

Individual compactors may be detached and used as manually-guided, self-propelled compactors for confined areas inaccessible to multi-unit machines.

Compactor power unit can be used as a lighting plant or for operation of small power tools.

Write for literature.

THE GALION IRON WORKS & MFG. CO.

General and Export Offices • Galion, Ohio, U.S.A.

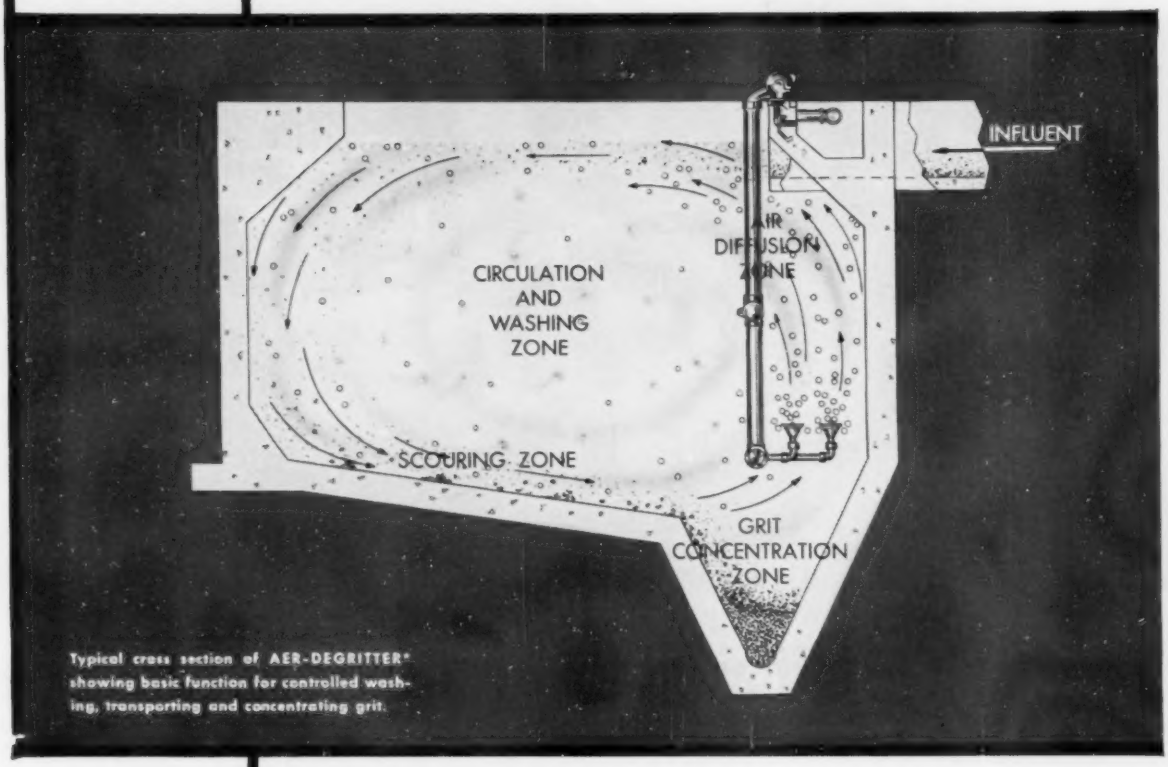
GALION
ESTABLISHED 1907

MOTOR GRADERS & ROLLERS

"from Chicago"

The WHY and HOW of SUCCESSFUL AERATED GRIT REMOVAL

Through the *AER-DEGRITTER** Grit Removal System



Typical cross section of AER-DEGRITTER* showing basic function for controlled washing, transporting and concentrating grit.

EXCLUSIVELY SUCCESSFUL COMBINATION of tank design and air diffuser location provides simultaneous grit washing and concentration, based upon:

- ADEQUATE AIR DIFFUSION for controlled circulating velocities.
- CORRECT LOCATION OF AIR DIFFUSERS (unobstructed) directly over the hopper causes complete circulation of tank contents for grit washing and transporting across entire tank bottom into grit hopper. (Air diffusers in wrong location will "short circuit" bottom circulating velocities and cause uncontrolled grit and organic pile-up on tank bottom.)

  Grit removal from tank hopper by Chicago Pump Company Air Lift pumps, tubular conveyors, screw or bucket elevators, clam-shell buckets or other means depending on specific job needs.

The AER-DEGRITTER® Aerated grit removal system is provided with Chicago Pump Company Swing Diffuser aeration equipment and, depending on requirements, Precision or FLEXOFUSER® diffusion tubes or Discfuser air nozzles.

ONLY THE AER-DEGRITTER HAS A PROVEN RECORD OF SERVICE . . . OVER 150 INSTALLATIONS

*The application of the equipment, as well as the equipment itself is covered by U.S. Patents No. 2,532,457, No. 2,328,655, No. 2,555,201 and pending patent applications.

always specify "Chicago"

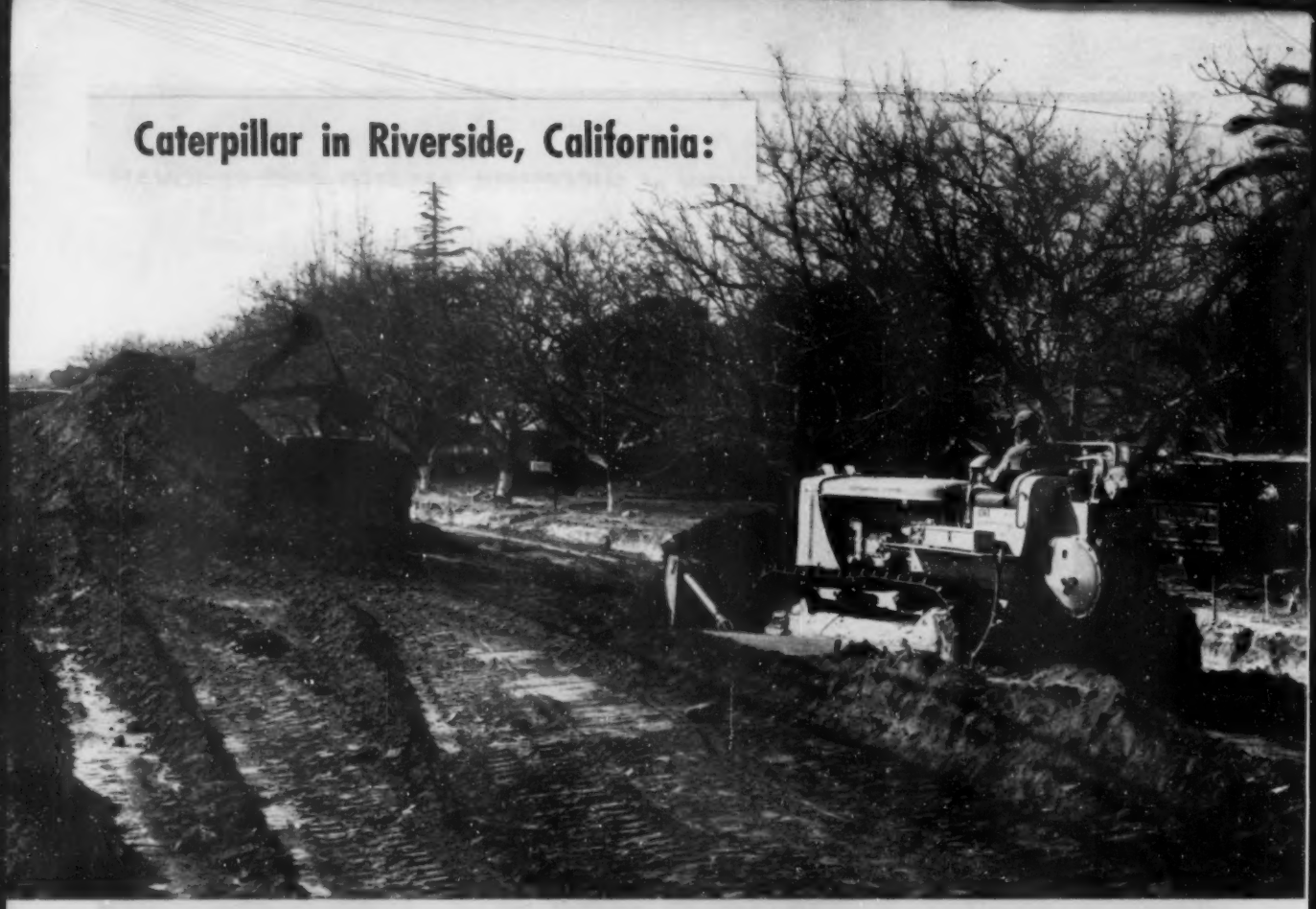
CHICAGO PUMP COMPANY

Sewage and Industrial Waste Equipment

Subsidiary of Food Machinery & Chemical Corporation

fmc

622 Diversey Parkway Chicago 14, Illinois



"24 years of efficient and satisfactory service"

THE Caterpillar D6 Tractor shown above is 'dozing on a street project in Riverside, California. The city also uses the D6 for clearing out trees, for backfilling on water lines and in its quarry. The report from Riverside: "We have owned Caterpillar-built equipment for 24 years and we have had efficient and satisfactory service."

Efficient service is as much a part of the Cat D6 Tractor as its famous yellow paint. It delivers 93 flywheel HP, 75 HP at the drawbar, and offers a maximum pull of 19,000 drawbar lb. It offers, too, the amazing Caterpillar Oil Clutch which sheathes the entire clutch mechanism in a bath of oil—and practically eliminates wear, maintenance or adjustment. And the D6 also offers a full range of matched tools to handle a variety of assignments.

More and more municipalities are finding that the power and versatility of Cat track-type Tractors can save taxpayers' money. Your Caterpillar Dealer is a power specialist. Ask him to demonstrate on *your* job the track-type tractor that's right for your municipality. He offers a size range all the way up to the massive D9 with its 320 flywheel HP. And remember, his reliable parts and service facilities stand behind your investment.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

YOUR TAXPAYERS GET THEIR MONEY'S WORTH WITH CAT-BUILT MACHINES

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BPA

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MAY 1958

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THE MOST USEFUL ENGINEERING MAGAZINE FOR CITIES, COUNTIES AND STATES

COSTS LESS TO BUY

A single, molded rubber gasket is the only accessory required. There are no bolts, no nuts, no followers, no couplings, no extras.

COSTS LESS TO INSTALL

Assembly is easy and rapid. Rate of installation usually is limited only by the speed of excavating the trench.

JOINT IS TIGHT

Bell-Tite forms a pressure-tight joint instantly. Restrained joint bursting tests prove joint stronger than the pipe itself.

This is it... CLOW Bell-Tite® Joint Cast Iron Pipe

ALL-WEATHER JOINT

You keep your schedules with Bell-Tite Joint cast iron pipe. It can be easily laid in a wet trench or even under water.

UNDERWRITERS' LISTED

All diameters through 24″ listed and inspected by Underwriters' Laboratories, Inc. for working pressures to 350 psi.

AMPLE DEFLECTION

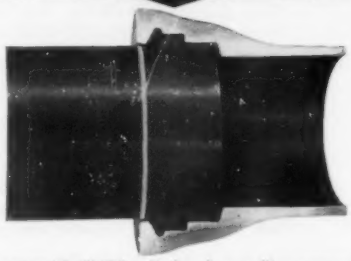
Bell-Tite Joint cast iron pipe is so designed that it will easily accommodate casual curves and normal grades.

MEETS ALL REQUIREMENTS

CLOW Bell-Tite Joint pipe is strong, tough, uniform and durable cast iron pipe for long-life underground service.

ANY SIZE OR THICKNESS

Available in any specified thickness or weight class in accordance with ASA, AWWA or Federal specifications. 3″ to 24″.



CLOW Bell-Tite Joint is easily assembled—Just wipe clean, lubricate and push spigot into the bell. When painted yellow stripe is no longer visible, joint is bottle tight.

ENTHUSIASTIC RECEPTION

Contractors and Municipalities—men who know pipe—have installed well over 1,000,000 feet of CLOW Bell-Tite pipe.

CLOW 1878

JAMES B. CLOW & SONS, Inc.

201-299 North Talman Avenue, Chicago 80, Illinois

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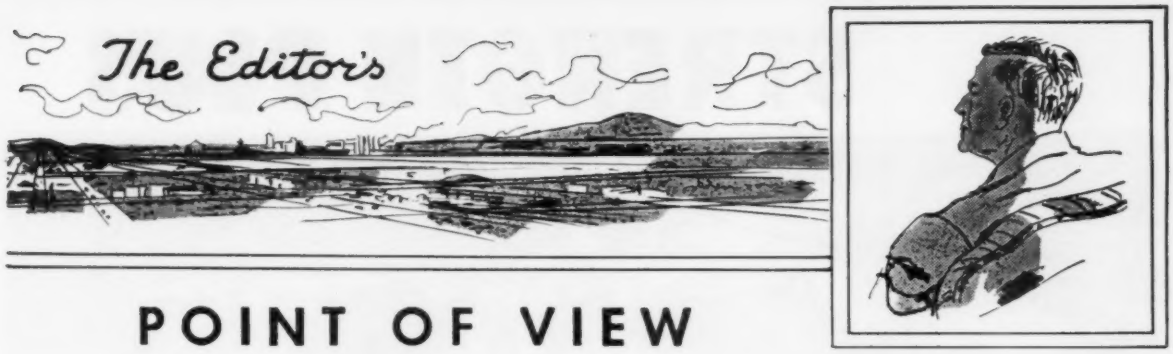


POINT OF VIEW

Overhead Power Line Troubles Show Need for Greater Reliability

THE RECENT HEAVY snows in the East resulted, as usual, in a crop of power failures with thousands of homes having no heat or light for two or three days. Snow and wind broke down poles and snapped cables while handicapping and delaying repair workers.

Under present-day conditions, electric power is almost as essential to public health as is water. In fact, in many suburban areas, water supply depends on the power supply. It still remains past time for utilities to start putting essential power lines underground, a kind of advanced thinking that is usually met with a flock of reasons why it can't be done.

Some of our water departments have been derelict in planning adequately for the future; but by and large the water works industry has accomplished a degree of reliability that the power industry can and should emulate. Loss of electric power is no longer merely an inconvenience; it is a menace to health; and, as such, should be subject to regulation accordingly. Here is a place for some of our Health Department personnel to show interest.

The Problem of 50 Million Tons a Year

THERE ARE something over 50 million tons of refuse being produced each year in this country—probably 200 million cubic yards. We are not doing a very good job of getting rid of it. As a matter of fact, we are not doing a very good job of local storage or collection, either, though perhaps less bad than in disposal. What we need in the refuse disposal line are more and bigger incinerators and more sanitary fills.

There are maybe 250 working incinerators and a thousand well-operated landfills. These probably handle less than one-third of the total refuse. The remainder is mostly disposed of with scant regard to sanitation and decency.

Here is a chance for leadership, not alone by health authorities, but by manufacturers as well. Any program should start at the grass roots—in local requirements for storage, reasonably frequent collection in enclosed bodies and proper disposal. This is a big job, but a needed one; and it can return much in reduced rodent, insect and nuisance production; and in increased property values.

Most communities pay for proper refuse handling whether they have it or not—in rodent damage, traps and poison; in insect sprays; and in exterminators' fees.

Reducing the Highway Accident Toll

REVIEWING the accident rate on 4-lane restricted access highways, it seems evident that they may pay a part of their cost by reducing automobile accidents. In the United States, there are about 40,000 deaths every year from such causes, with 1,350,000 non-fatal injuries. Property and other damages are estimated at upward of $7 billion. If an accident reduction of only 10 percent were attained by reason of the Interstate System, the cost to the nation for these better highways would be materially reduced. Actually, the fatality rate for all turnpikes was less than half of the national average in 1956, the last year with complete figures available.

Cities and counties have many highways that carry large volumes of traffic and account for many accidents. Competent studies should be made of these accident factors so that, where needed, early steps can be undertaken toward better and safer construction, preferably by restricted access and careful intersection planning. These cost money, but they save lives, time and financial loss.

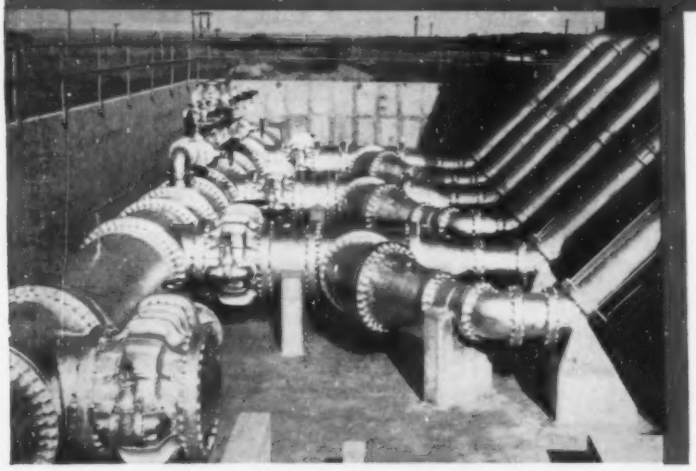
Playing Fair with Consulting Engineers

NOT SO LONG ago a city invited eighteen consulting engineers to attend a council meeting at which a proposition for a new sewer system and treatment plant was presented. It was conservatively estimated that the out-of-pocket cost for being present was, for these eighteen consultant representatives, at least $5000. However, the matter was by no means settled at this one meeting since the engineers were requested to present their views at later meetings.

It would seem possible to invite three or four skilled and carefully selected engineers, instead of eighteen, still getting competent engineering services while reducing the overall expense and time requirements on the part of the unsuccessful ones. That is, instead of seventeen who spent money and time without return, there would have been two or three. In this particular case, some firms were finally passed over because of the distance between their headquarters and the city which invited them—a fact certainly known when the invitation was first presented.

STRENGTH PLUS

Chicago, Ill.—Cast Iron Pipe for installation of new water main under West Madison Street.



Corpus Christi, Texas—Cast Iron Pipe installation in filtration plant showing 48" discharge manifold which is connected to 48" Cast Iron city supply line.

THE MAN WHO CHOOSES
CAST IRON PIPE TODAY
WON'T PAY FOR IT AGAIN
TOMORROW!

CAST IRON

Cast Iron Pipe Research Association
Thos. F. Wolfe, Managing Director
Suite 3440, Prudential Plaza, Chicago 1, Ill.

MODERNIZED **cast iron**

HIGH FLOW

You get BOTH with CAST IRON PIPE

*Here's the proof of flow

FLOW FACTORS FOR CEMENT LINED CAST IRON PIPE

LOCATION	SIZE	TEST SECT. IN FEET	VELOCITY F.P.S.	AGE YEARS	W & H "C" FACTOR
Bowling Green, Ohio	20"	45,592	0.7-2.4	New	142.5
Chicago, Illinois	36"	7,200	2.6-3.6	New	147
New Orleans, La.	12"	39,650	1.2-2.9	New	141
Corder, Mo.	8"	21,350	0.9-2.3	New	143
Univ. of Illinois	8"	400	3.14	New	150
Concord, New Hamp.	14"	500	1.7-2.2	New	151
Concord, New Hamp.	12"	500	2.0-3.4	11	142
West Palm Beach, Fla.	12"	500	3.6-5.4	15	139.5
Greenville, S. C.	30"	87,376	2.4-2.7	12	148.5
Corpus Christi, Tex.	30"	65,641	1.1-1.8	6	146
Summerville, S. C.	8"	500	1.98-2.43	13	142.5
Champaign, Illinois	16"	3,920	3.1-5.6	22	139.3

*Available upon request: Booklet containing flow test and tables on Cast Iron Pipe.

Here's the proof of strength

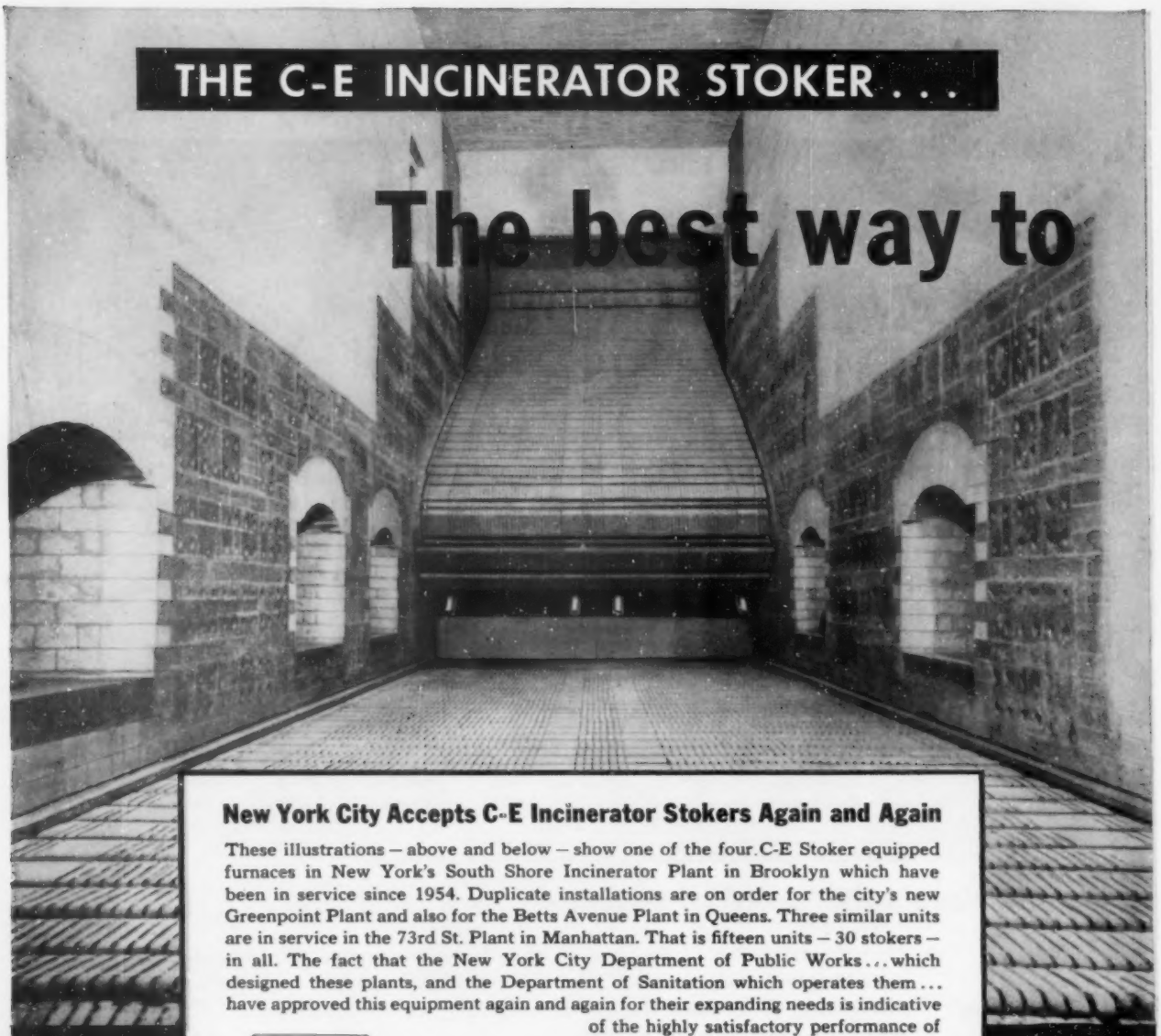
1. CRUSHING STRENGTH* . . . Standard 6" Class 150 cast iron pipe will withstand a crushing load, under standard tests, of 17,900 pounds per foot . . . important where heavy fill or shock from heavy traffic loads are encountered.
2. BEAM STRENGTH* . . . Settlement soil movement, or disturbance of the soil by underground construction places a heavy strain on pipe. A length of 6" class 150 cast iron pipe bears up under a load of 20,790 pounds and deflects over 2¼ inches.
3. BURSTING STRENGTH* . . . Tests prove that standard 6" class 150 cast iron pipe withstands internal pressure of 3000 pounds per square inch . . . providing a safety factor ample to resist high working pressures and water hammer.
4. JOINT STRENGTH . . . A full range of leak-proof, low cost, easy-to-assemble joints for pipe and fittings are available to meet all conditions.
5. CORROSION RESISTANCE . . . Cast Iron Pipe resists corrosion . . . vital factor in its proven long life and dependability.

*Based on independent laboratory tests.

pipe FOR MODERN WATER WORKS

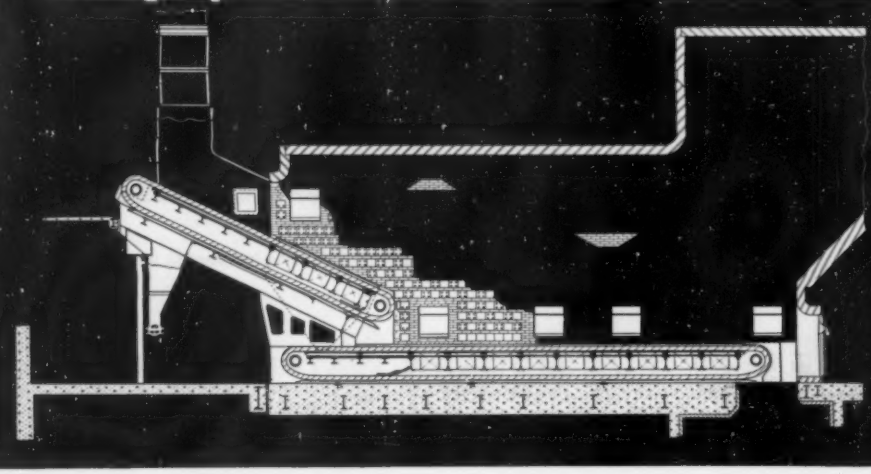
THE C-E INCINERATOR STOKER . . .

The best way to



New York City Accepts C-E Incinerator Stokers Again and Again

These illustrations — above and below — show one of the four C-E Stoker equipped furnaces in New York's South Shore Incinerator Plant in Brooklyn which have been in service since 1954. Duplicate installations are on order for the city's new Greenpoint Plant and also for the Betts Avenue Plant in Queens. Three similar units are in service in the 73rd St. Plant in Manhattan. That is fifteen units — 30 stokers — in all. The fact that the New York City Department of Public Works . . . which designed these plants, and the Department of Sanitation which operates them . . . have approved this equipment again and again for their expanding needs is indicative of the highly satisfactory performance of the initial South Shore installation.



burn municipal refuse

The C-E Incinerator Stoker has numerous points of superiority but the foremost of these is its perfect suitability to the *"continuous"* process of refuse incineration. There is a tremendous saving in the labor required for operation over that necessary for the widely used *"batch"* process.

From the time the refuse is deposited into the self-sealing, non-clogging, feed hopper until the incinerated residue is ready to be hauled away, only minimum operating attention is required. A comparison between a C-E equipped "continuous" process furnace and any contemporary "batch" process installation will prove a revelation to anyone concerned with the problems of refuse disposal.

The decontaminated refuse as it comes from the C-E Incinerator Stoker provides a sanitary inoffensive fill for reclamation of waste lands, swamps and other recoverable areas.

Where there is need for steam for heating, power or process, the addition of a waste heat boiler to utilize the heat produced by the incinerator provides an exceptionally desirable and economical arrangement. Auxiliary oil-firing equipment can be supplied to assure continuity of steam output irrespective of incinerator load.

The C-E Incinerator Stoker is designed to handle all types of combustible refuse in quantities ranging upward from 50 tons per 24-hour day.

For further information, please contact the Combustion office in your city or write directly to Combustion Engineering, Inc., 200 Madison Avenue, New York 16, N. Y.

INDUSTRIAL REFUSE

Get rid of *industrial refuse, too,* with the C-E Incinerator Stoker. Add a Waste Heat Boiler if additional steam is required

New York City's South Shore Incinerator Plant where four furnaces equipped with C-E Incinerator Stokers have been in service for three years.

HIGHLIGHTS OF C-E DESIGN

- Large hopper and chute provide sealed, continuous supply of refuse.
- Unobstructed, non-clogging feed of refuse.
- Continuous, positive advance of fuel bed from front to rear.
- Zone control of air to fuel bed.
- Continuous discharge of residue from grate surface.
- Easy to operate—no heavy stoking or cleaning of fires.
- Chrome cast iron — most suitable material — used for grate surface.
- Wide keys over driving chains prevent fouling.
- Easily replaceable grate elements.
- Steel driving chains take all tension.
- Take-up mechanism easily accessible at front.
- Assures maximum availability.
- Provides most economical method of disposal.
- Applicable to largest incinerators.
- Requires less labor than any other burning method.

COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

C-108A

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS, SOIL PIPE

Economy-priced INTERNATIONAL cab-forward models give you short 89-inch bumper-to-back-of-cab dimension for greater ease of handling. All have more powerful six-cylinder engines. Four-wheel, six-wheel and all-wheel-drive models range from 9,000 to 33,000 lbs. GVW in the world's most complete truck line.

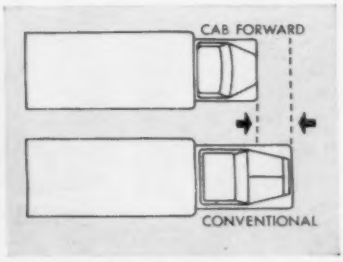
Unique double-duty vehicle—the new INTERNATIONAL Travelette.® Seats six big men comfortably in two full width seats. Hauls up to a full ton payload in the all-steel 6-ft. pickup body. Service-utility body and four-wheel-drive models available.

INTERNATIONAL TRUCKS

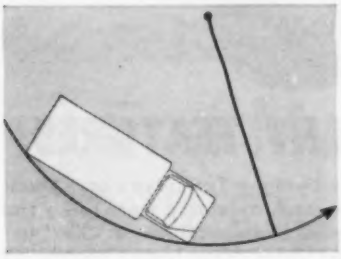
More for the taxpayer's dollar

Just one reason municipalities find International Trucks cost least to own!

Low first cost. INTERNATIONAL cab-forward trucks are priced down with the lowest and quality-built throughout.

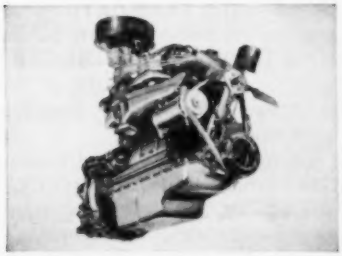


Cab-forward design permits the same payload in sixteen inches less overall length than conventional-cab units.

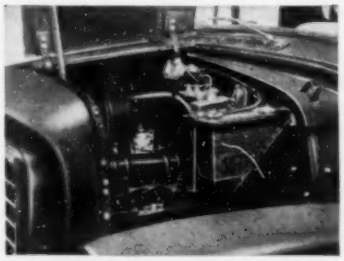


Easier, smoother handling anywhere due to short turning circle, overall clearance and minimum front overhang.

Most convenience. Cab roof is only 3¼ in. higher than conventional models. Low step. Better all-around vision.



Lively, low-cost performance. Popular six-cylinder engines offer more usable power with fuel-saving economy.



Save service time and money. Large side-opening hood for complete access to engine compartment and components.

Your community gets more "value received" when you buy new cab-forward INTERNATIONAL Trucks.

These trucks are short in length—with the ruggedness and job efficiency that have kept INTERNATIONAL first in heavy-duty sales for 26 straight years. They're dependable on all kinds of work and in all kinds of weather. They turn in shorter circles—park in less space. The driver has a better view and an easier job at the wheel.

Best of all, *they save you money.* Purchase price is low. Operating and maintenance costs stay low as the mileage piles up.

These are no empty statements. Cost records *prove* that INTERNATIONAL Trucks cost *least* to own.* Your INTERNATIONAL Dealer will give you complete details and specify the right models for your job from the world's most complete truck line. Why not see him soon?

**Signed statements in our files, from fleet operators throughout the U. S., back up this statement.*

cost least to own!

INTERNATIONAL HARVESTER COMPANY, CHICAGO

Motor Trucks • Crawler Tractors
Construction Equipment • McCormick® Farm Equipment and Farmall® Tractors

it's NEW! the Ottawa BACKHOE now mounts on the CHEVROLET TRUCK!

WORK MANY JOBS — IN DIFFERENT AREAS — THE SAME DAY!

WITH NEW IMPORTANT FEATURES!

• Digs 12½ feet deep • Has 190° continuous swing • Turret-type seat pivots with boom • Reverse-mounted cylinders place rods up safely from rocks and dirt • Rod-fed cylinders do away with exposed hydraulic lines • "Bite" has 7,000 lb. force at bucket edge • Two levers (dual "One-Trols") control all backhoe actions • Ejector bucket automatically forces all wet sticky material from bucket • Hydraulic laydown shifts backhoe up and over rear axle for perfect roadability • Quick on-and-off frees truck for other work in minutes!

WORK MANY JOBS — IN DIFFERENT AREAS — THE SAME DAY!

The Ottawa Truck-Mounted Backhoe is designed to meet the need of public utilities, plumbers and contractors for a COMPLETELY MOBILE DIGGER! It's an UNBEATABLE COMBINATION for

MUSCLE! The powerful hydraulic system of the Ottawa "Big Muscle" Backhoe provides EXTRA POWER for fast, smooth, economical operation!

MOBILITY! Use it anywhere, anytime . . . one job or several jobs at different locations during one day! The Ottawa WORKING UNIT is also the MOBILE UNIT ready to move anywhere with great roadability, ready for operation seconds after arrival at a new jobsite!

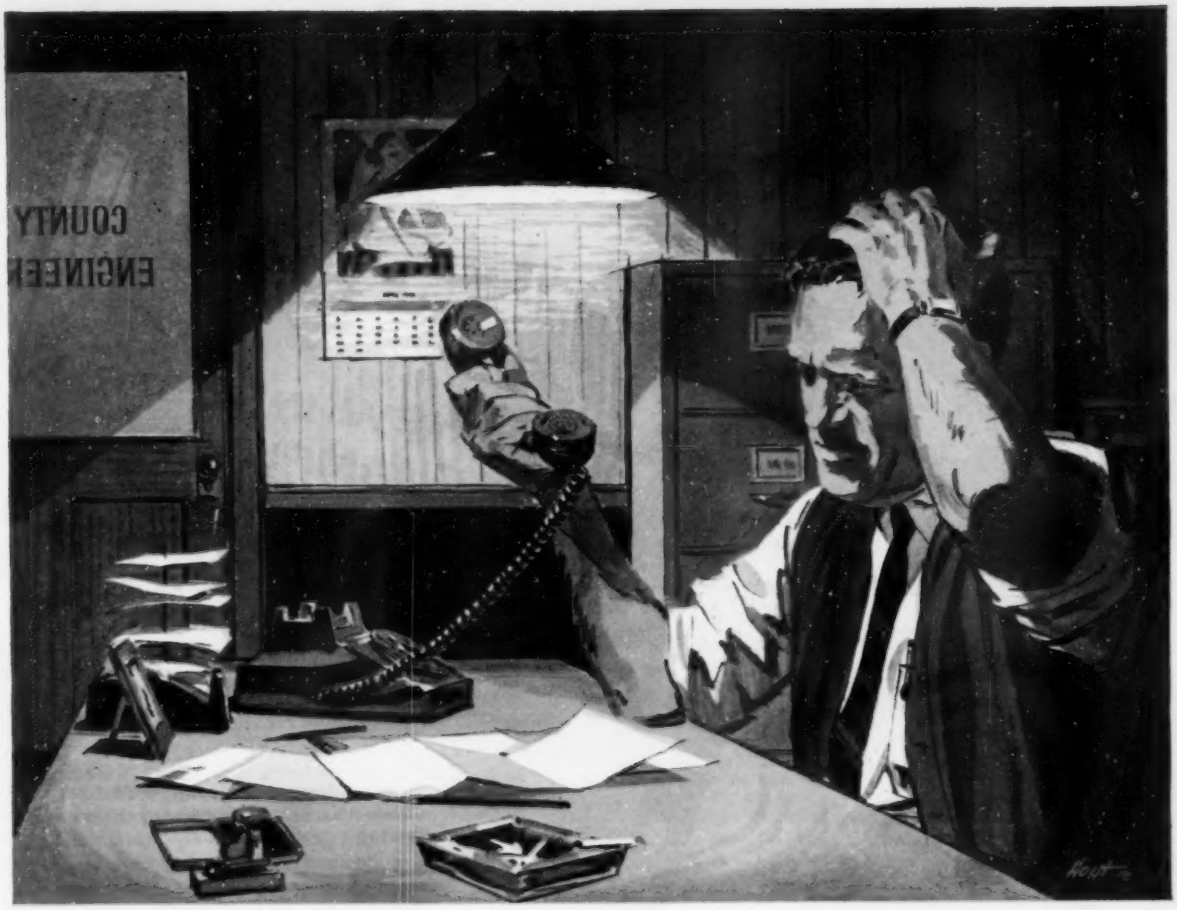
VERSATILITY! Dig trenches and ditches faster . . . load dirt direct from trench to truck . . . dig square graves that need no hand finishing . . . dig and maintain irrigation channels . . . clean roadside drainage ditches . . . dig building footings and septic tanks . . . use as a boom to lay lightweight pipe . . . the Ottawa Backhoe is COMPLETELY MOBILE to your needs!

Ottawa

OTTAWA STEEL DIVISION
Young Spring & Wire Corp.
Ottawa, Kansas

BUY the Ottawa BACKHOE and the Chevrolet TRUCK! GET the BEST BENEFITS of each . . . PLUS . . . the NEW, DYNAMIC ADVANTAGES of the COMBINATION TRUCK-BACKHOE!

AVAILABLE ONLY AT YOUR CHEVROLET TRUCK DEALERS!



End Maintenance Complaints! Salt Stabilize Your Gravel Roads

Build better roads that keep everybody happy by stabilizing with Morton Salt

As a wearing course, salt stabilized roads give motorists a smoother, safer ride and create less dust. When you stabilize with Morton Salt you get the added satisfaction of putting in roads with durable surfaces which reduce frost action, minimize loss of expensive aggregate (the savings in aggregate alone more than pay for the salt), and require far less maintenance.

As a base course, Morton Salt stabilized roads form an ideal bond with most types of bituminous material. With added stability, increased load bearing strength, improved bond and controlled frost action, salt stabilizing reduces the need for most costly and heavier surface courses.

Please send me
your free booklet
on salt stabilized roads.

Name_____
(Please print)

Title_____

Address_____

City_____ Zone____ State_____

MORTON SALT COMPANY
INDUSTRIAL DIVISION
Dept. PW-5-58, 110 N. Wacker Drive
Chicago 6, Illinois

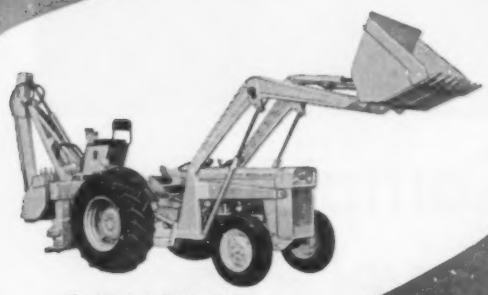
MASSEY-FERGUSON

PRESENTS

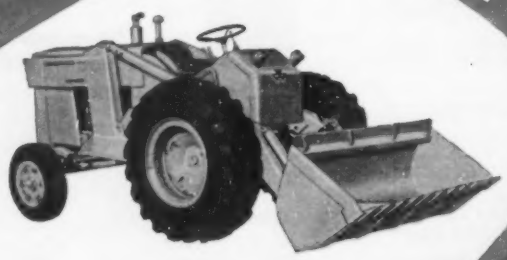
FOUR NEW INDUSTRIAL CHAMPIONS

WORK BULL and DAVIS PRODUCTS

The Work Bull 303 with 500 Loader and Davis Backhoe



The Work Bull 202 with Matched Davis Loader and Backhoe



The Work Bull 1001 Multi-Purpose Tractor Loader

The Work Bull Fork Lift

Here's Massey-Ferguson Industrial Division's new line of industrial champions in the light and medium equipment field. All are designed to replace high-inventory, single-purpose machines — and at a fraction of the cost. Multiple, quick-change attachments are POWER-MATCHED to the basic tractor. You pick the power you need — and add the attachments you want. All from the same source. It will be the best investment you ever made in equipment!

SEE HOW THEY SAVE MANPOWER AND EQUIPMENT COSTS!

New WORK BULL 1001

Multi-Purpose Tractor Loader is convertible into eight different machines. You can change it in the field from a loader (⅞ cubic yard payload capacity) to a pick-up street sweeper, to a fork lift, angle dozer, crane, rotary broom, backhoe, or scarifier. This unit features 52 h. p. engine, instant reversing (without shifting), 43° bucket roll back at ground level, load-shock absorber, power steering, and torque converter.

New WORK BULL 202

Utility Industrial Tractor has 40 h. p., high-torque engine with amazing lugging power at low speeds. New industrial design permits extra maneuverability, vision, and control. It has more POWER-MATCHED attachments than any other tractor. Attachments include the famous Davis Loader-Backhoe and the Auburn Trencher. It beats anything in its price range.

New WORK BULL 303

Medium Range Industrial Tractor is designed for tough assignments that demand more power, more weight, and reserve stamina. It has 52 h. p. engine, instant reversing, torque converter, power steering, and new double-disc brakes.

New WORK BULL 500 LOADER

Work Bull 500 Loader with ¾ cubic yard payload capacity is specially matched to the Work Bull 303. It has direct line "bull-dozer" type thrust, but telescopic reach. Extra versatility is provided by pick-up street sweeper, crane, angle dozer, rotary broom, fork lift, and scarifier attachments. Davis Backhoe also fits directly to the loader frame.

New WORK BULL FORK LIFT

Work Bull Fork Lift has the power, stability, and flotation to be labeled the best material-handling device for either off or on hard surfaces. Controls are located at operator's finger-tips. It is equipped so you can make quick changeover from one attachment to the other without additional hydraulics. Attachments include standard tines, block forks with side-shift adjustment, hydraulic bucket, log hook, dozer blade, scrap grap, 20′ extension mast, bottled gas load clamp, and cotton bale clamp.

Matched DAVIS LOADER-BACKHOE

Davis Loader-Backhoe — The famous Davis Loader and Backhoe are specially matched to Work Bull 202. Loader attaches directly to the tractor which also has built-in pump drive and mounting. The Davis Backhoe fits directly to loader frame and can be attached or detached in less than five minutes. It is the only machine that can dig flush alongside a building – as well as do normal digging jobs. The Davis Loader, likewise, is highly versatile with many easy-to-change attachments.

Other ***Power-Matched Attachments*** for the Work Bull 202 and 303 tractors include a scarifier-scraper, post hole digger, mower, multi-purpose rear blade, soil scoop, cable layer, tipping trailer, cordwood saw, and telescoping wagon chasis.

MASSEY-HARRIS-FERGUSON, INC.

Get the Full Story On How To Save Manpower and Equipment Expenditures Write for this free copy of the 28-page, fully illustrated brochure on the complete Work Bull and Davis Line. Ask for Brochure G-4.

MASSEY-FERGUSON INDUSTRIAL DIVISION

1009 SOUTH WEST ST. • WICHITA 13N, KANSAS

Work Bull 202 and Davis Loader are made for each other.

Work Bull 1001 has instant reversing, 43-degree roll back.

The Work Bull 500 Loader and 303 has telescopic reach.

Davis Backhoe digs flush or from center.

85 cfm GYRO-FLO Compressor

The capacity, weight, size and the POWER you want for municipal maintenance

Yes, this is *it!* The smallest, lightest weight portable rotary air compressor ever developed. The ideal air power plant for hundreds of municipal maintenance jobs like the one shown above.

This 85 cfm rotary compressor, smallest member of the famous Ingersoll-Rand Gyro-Flo line, has ample power to operate a multitude of the small air operated rock drills and pneumatic tools that are used so frequently on municipal maintenance jobs. It weighs only 1724 lb. complete with running gear, and 1469 lb. stripped for truck mounting.

Like all Gyro-Flo units, it gives you *smooth, dependable* air power. And its maintenance cost is so low you'll hardly believe it. Other Gyro-Flo compressors are available in sizes to 900 cfm.

Ask your Dealer or I-R Representative for complete information. Or write for Bulletin 2307.

Ingersoll-Rand

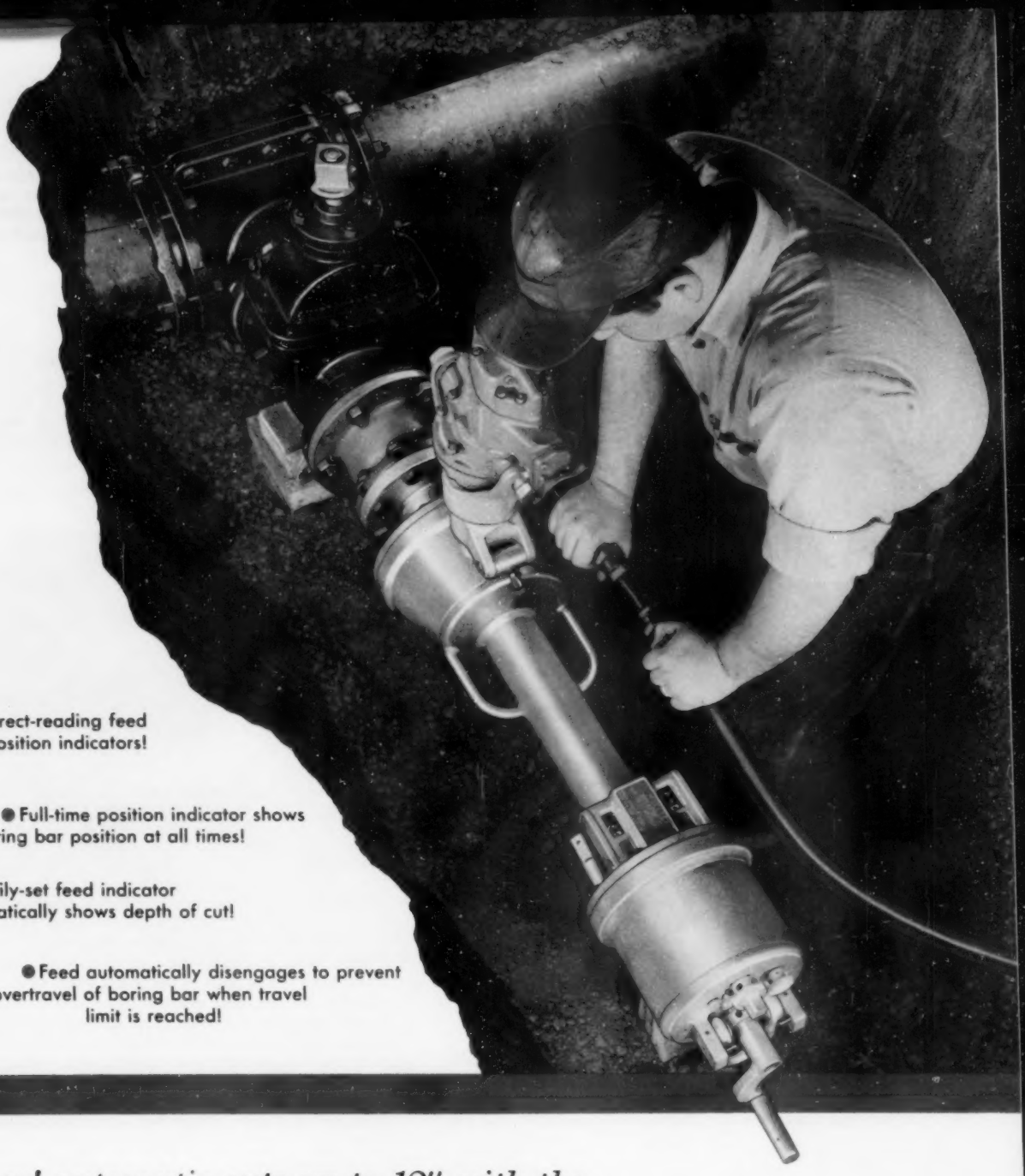
2-834 11 Broadway, New York 4, N. Y.

AN UNBEATABLE COMBINATION . . . GYRO-FLO COMPRESSORS AND I-R ROCK DRILLS

LEADER IN PUBLIC WORKS

Leonard H. Caro, Director of Streets and Sewers, is responsible for the maintenance activities for streets, sewers and bridges for the City of Peoria, Ill., and has charge of the Central Garage and equipment pool which purchases, services and maintains Peoria's fleet of equipment and vehicles. He entered the engineering field as a record draftsman with Michigan Bell Telephone Co. in 1941. War interrupted this job and in 1942 he entered the navy for duty which took him to the south and southwest Pacific theaters as a shipboard operator during World War II. Returning to Michigan Bell in 1946, he spent a year as assistant field plant engineer before undertaking to get an engineering degree. He received his BS in 1950 from the Massachusetts Institute of Technology where he took a planning and administration option in civil engineering. Employed by the city of Grand Rapids, Mich., for a year following graduation, he was called back to military service for the Korean conflict and served as Lieutenant in the Corps of Engineers. He returned from service in 1953 to Grand Rapids where he worked as project engineer, resigning to enter the University of Michigan for postgraduate work where he earned his MS degree in municipal engineering administration. After graduation he went to the engineering department of Peoria as project, administration and research engineer.

He is a registered professional engineer and is an associate member of the ASCE, Central Illinois Section. Also, he is a cooperating member of the International Association of City Managers; Captain in the Corps of Engineers, USAR; and a member of the Masonic Lodge. He says that most of his spare time is spent puttering around the house or assisting his wife Mary in the rearing of their three small boys so there isn't much time for special projects or hobbies.



- Direct-reading feed and position indicators!
- Full-time position indicator shows boring bar position at all times!
- Easily-set feed indicator automatically shows depth of cut!
- Feed automatically disengages to prevent overtravel of boring bar when travel limit is reached!

Now! automatic cuts up to 12" with the

NEW MUELLER® CL-12

Machine!

New design and new features give automatic operation for faster, safer cuts; more strength for reduced maintenance; simplified operation for use by inexperienced personnel; more compact for easier handling; and standardized tools for simpler tool selection.

MUELLER CO.

DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles; in Canada: Mueller, Limited, Sarnia, Ontario

FORM NO. W-8881

NEW *self-adjusting boring bar packing*

High temperature chevron packing is spring-loaded to insure positive, leakproof sealing without packing adjustments. Line pressure does not enter case.

NEW *rugged all-steel construction*

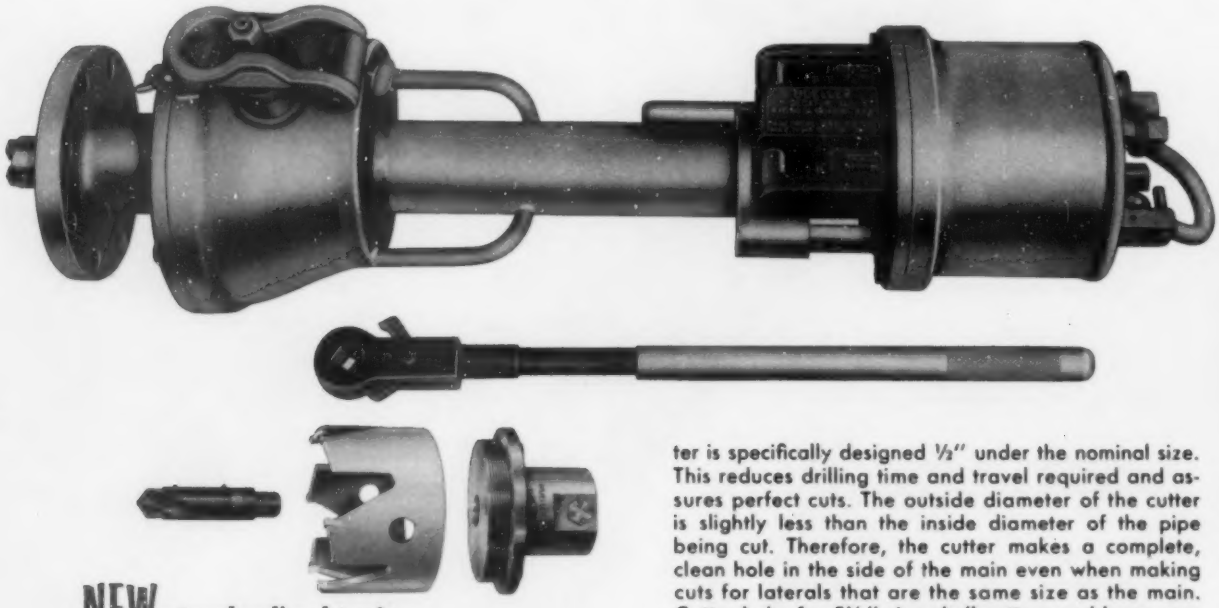
All working parts are totally enclosed in a galvanized steel case to permit complete lubrication and to prevent damage from dirt or other foreign matter and from rough handling. Lubricant is sealed in with "O" rings. Large bearing surfaces assure boring bar rigidity.

NEW *power or hand operation*

May be hand operated with ratchet handle or power operated with Mueller H-601 Air Motor or Mueller H-602 Gasoline Engine Drive Unit. No changes are required in the machine to use hand or power operation.

NEW *handling ease*

Telescopic design reduces over-all length and weight. Conveniently placed handles and lifting yokes permit easy handling of machine—manually or with hoisting equipment. Front lifting yoke may also be used to lock the boring bar while attaching or removing tools.



NEW *standardized tools*

Tungsten carbide tipped shell cutters are designed for cutting cast iron, cement-lined cast iron, asbestos-cement, reinforced concrete and steel pipe. Tool selection and inventory are greatly reduced. Each shell cutter is specifically designed ½" under the nominal size. This reduces drilling time and travel required and assures perfect cuts. The outside diameter of the cutter is slightly less than the inside diameter of the pipe being cut. Therefore, the cutter makes a complete, clean hole in the side of the main even when making cuts for laterals that are the same size as the main. Cutter hubs for 5½" size shell cutters and larger are of the "E-Z-Release" type. All pilot drills screw into the cutter hub to give greater rigidity and perfect centering. Pilot drill contains a mechanical coupon retaining device. The cutter, hub, pilot drill and coupon can be removed as a unit without first removing coupon.

NEW CL-12 FEATURES

. . . designed to reduce your cutting time!

Now! a new, automatic drilling machine

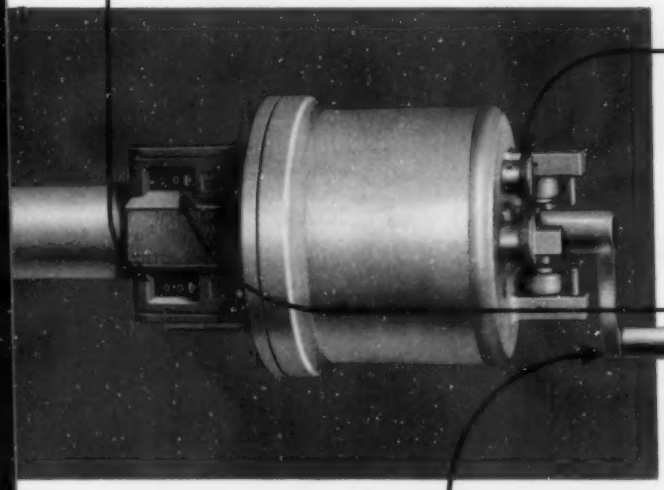
for 2" through 12" cuts in any type of pipe!

NEW *automatic tool position indicator*

Direct-reading indicator shows—at all times—the position of the pilot drill and shell cutter in relation to their fully-retracted or rearmost position. Large numerals read in inches and tenths of an inch and automatically add as the tool is advanced and subtract as the tool is retracted. Eliminates tool position guesswork.

NEW *automatic overtravel protection*

Tool feed is automatically disengaged when the maximum 25" travel of the machine is reached. Damage to the machine is prevented—even when the automatic feed has been set for travel beyond the maximum travel of the machine.



NEW *automatic feed-setting*

The amount of travel required in automatic feed can be quickly and accurately set in inches and tenths of an inch. This amount is clearly shown on the automatic feed travel indicator to insure accurate settings every time.

NEW *automatic feed travel indicator*

As the cut progresses, the direct reading indicator automatically subtracts—always showing the amount of travel remaining in automatic feed. You always know just how much of the cut remains to be made.

NEW *rapid hand travel*

When not cutting, the boring bar may be quickly and easily advanced or retracted by hand. Rapid advancement and retraction of the boring bar reduces time of operation.

NEW *automatic feed disengagement*

When the preset travel in automatic feed is completed and the indicator reads zero, the tool feed is automatically disengaged to prevent damage and loss of time.

Check with your Mueller Representative for complete details.

MUELLER CO. DECATUR, ILL.

specifications

MUELLER CL-12 *drilling machine*

Capacity and Use

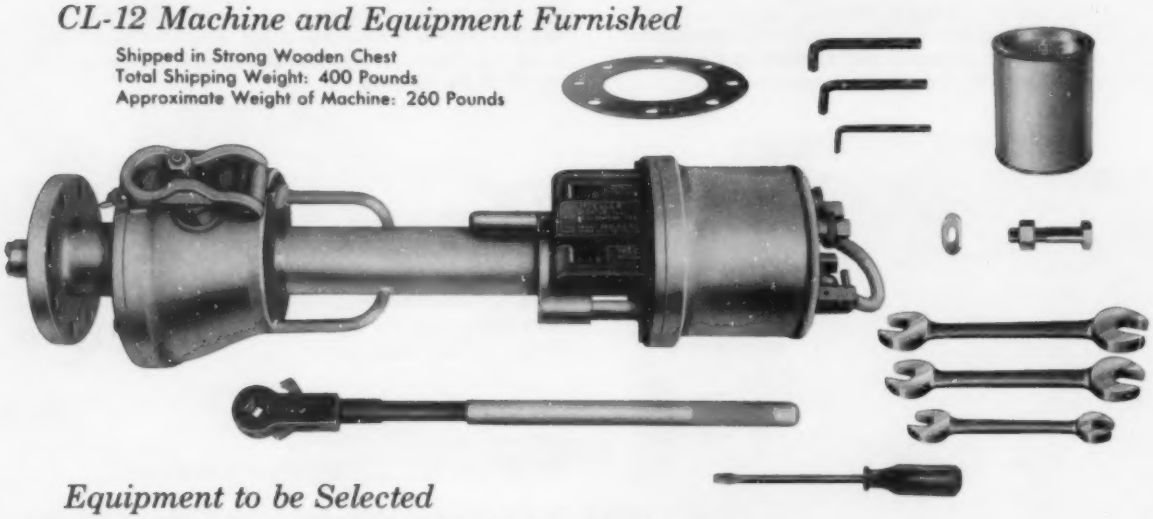
The CL-12 Machine makes cuts from 2" through 12" inclusive in any type of pipe. It is used with tapping sleeves and valves to make lateral connections up to 12" under pressure and to install inserting valves up to 8" in size under pressure.

Working Pressure and Temperature

250 p.s.i. at 100° F.
500° F. at 150 p.s.i.

CL-12 Machine and Equipment Furnished

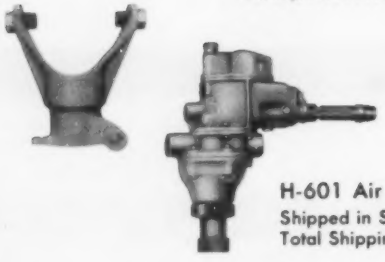
Shipped in Strong Wooden Chest
Total Shipping Weight: 400 Pounds
Approximate Weight of Machine: 260 Pounds



Equipment to be Selected

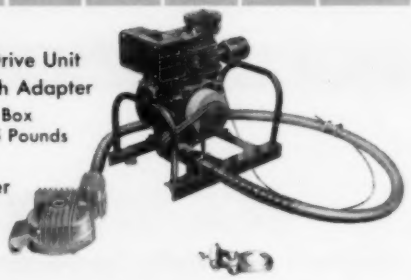
Power Operating Units, Cutting Equipment (cutter, pilot and hub) and Adapters.

	TAPPING VALVES							
Size of valve ...	2"	2-⅛"	3"	4"	6"	8"	10"	12"
Size of Drill ..... or Shell Cutter	2"	2"	2-½"	3-½"	5-½"	7-½"	9-½"	11-½"
Drill.....	64567	64567	....	....	....	....	....	....
Boring Bar Adapter....	83666	83666	....	....	....	....	....	....
Shell Cutter.....	....	....	83617	83203	83134	83135	83140	83141
Cutter Hub	....	....	83599	83671	83673	83676	83679	83682
Pilot Drill	....	....	83634	83634	83639	83675	83678	83681
Machine Adapter (For Mechanical Joint Tapping Valve)*.....	83668	83669	83367	83368	83369	83370	83371	83372
*Bolts, Nuts ..... and Washers.....	2 ea. 36445	2 ea 36445	Furnished with each Mechanical Joint Tapping Valve 3" size and larger.					
Machine Adapter (For Hub End Tapping Valve).....	83770	....	83361	83362	83363	83364	83365	83366



H-602 Gasoline Engine Drive Unit with Adapter
Shipped in Strong Wooden Box
Total Shipping Weight: 265 Pounds

H-601 Air Motor Power Unit with Holder
Shipped in Strong Wooden Box
Total Shipping Weight: 95 Pounds



Order by Quantity and Catalog or Part Number

MUELLER CO.
DECATUR, ILL.
Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario

Printed in U.S.A.

There's a Barber-Greene ditcher to speed your jobs . . . to cut your costs

The two most advanced ditchers on the market. Left: Model 774 with wheel. Right: Model 784 with vertical boom.

Two machines in one. The same chassis can be used with wheel for cross-country digging where speed is important or with vertical boom for city work where tight quarters and frequent obstructions are encountered.

The Model 774 Wheel Ditcher digs to 66″ deep, 30″ wide. Model 784 Vertical Boom Ditcher cuts to 7′ deep, 24″ wide. Both machines offer exclusive dual-range Hydra-Crowd for infinitely variable digging speeds to 31′ per minute, hydraulic controls, hinged connector between chassis and boom that eliminates twist and tilt, all-hydraulic spoil conveyor, automatic overload protection, new crawlers, and many other years-ahead advantages.

Crowding speed independent of wheel or bucket line speed. Can be changed instantly without stopping machine. Conveyor speeds infinitely variable—instant reverse.

House services. Model 705-B Runabout digs to 48″ deep or more, 10½″ wide. Favorite among utilities for house services. Vertical boom digs up to obstructions, leaves no ramp. Hydra-Crowd gives infinitely variable digging speeds. 15 m.p.h. travel.

Scattered jobs. Model 711 digs to 5′ deep and 18″ wide. 45 m.p.h. travel speed minimizes between-job time. One-man operation. Hydra-Crowd assures instant selection of correct crowding speed for every digging condition. Convenient operator's cab.

Narrow trenching. The Model 702 is a remarkably low-cost unit that digs to 5″ wide, 40″ deep. Ideal for cable, conduit, small pipe. Highly mobile. Varidraulic drive gives finger-tip control of crowding speeds from 0 to 20′ per min. Exceptionally rugged.

58-7-D

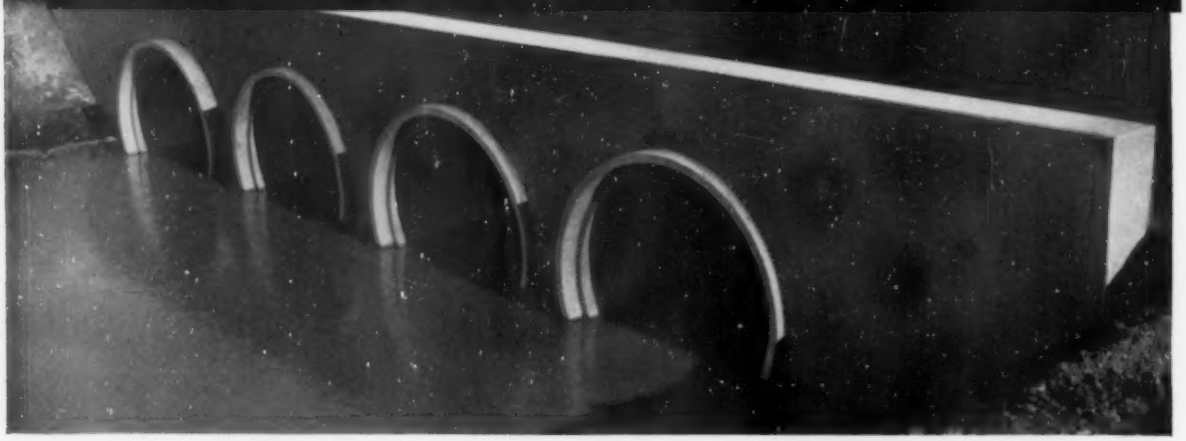
Write for information on all ditchers in the Barber-Greene line of advanced design.

Barber-Greene BG

AURORA, ILLINOIS, U.S.A.

CONVEYORS . . . LOADERS . . . DITCHERS . . . ASPHALT PAVING EQUIPMENT

STRATEGICALLY LOCATED AMERICAN-CONCRETE PRODUCTS FOR MULTI-



ROUND PIPE

As the nation's largest maker of concrete culvert and drainage pipe, American-Marietta offers contractors round pipe of known permanence and performance. A full range of sizes is available, with pre-tested strengths to meet various specifications. For extreme loads see Hi-Hed Pipe, below.

HI-HED PIPE

Elliptical Hi-Hed Reinforced Concrete Pipe permits greater self-cleansing velocities in dry weather periods. Also perfect for drainage structures under unlimited fills because Hi-Hed has 50% greater strength than its round pipe equivalent.

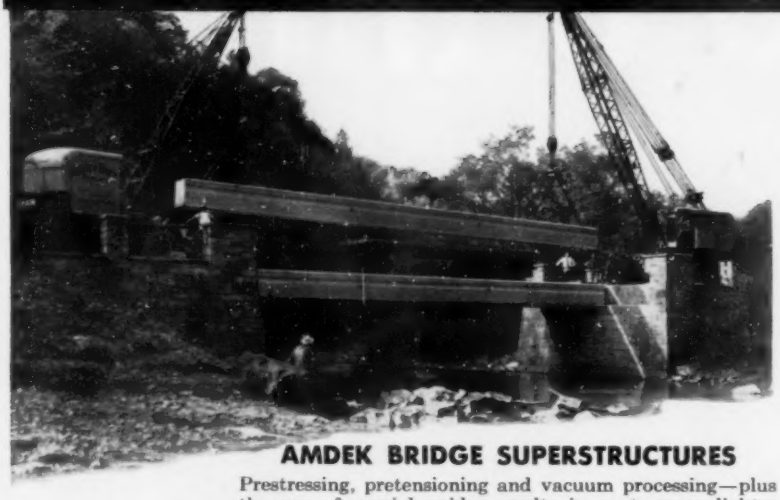
FLAT BASE PIPE

Save as much as 30% in the construction of pedestrian underpasses, culverts and cattle passes with pre-cast Flat-Base Pipe. Can be jacked under highways without disturbing traffic.

CONCRETE CRIBBING

Used as a retaining wall, both open-faced and closed-face "King-Size" Cribbing offer flexible construction unaffected by movements that crack monolithic walls.

MARIETTA PLANTS READY TO SUPPLY BILLION DOLLAR HIGHWAY PROGRAM



AMDEK BRIDGE SUPERSTRUCTURES

Prestressing, pretensioning and vacuum processing—plus the use of special voids—results in a stronger, lighter bridge member that can be handled like steel beams in any weather. Pre-cast Amdek sections, above, were positioned in just six hours. Amdek eliminates painting and maintenance.

A giant in the construction materials industry, American-Marietta offers a related group of essential concrete products for use in building and rebuilding the nation's highways. American-Marietta has expanded its plants to supply the increased demand and to prepare for still more volume. Manufacturing facilities are strategically located throughout the United States to assure distribution near points of use. Send for complete information about any of the products illustrated on these pages.

LO-HED PIPE®

Elliptical Lo-Hed Pipe carries a greater flow than its round equivalent—in a minimum depth of cut with increased depth of cover. Easier to lay, to grade and line. Pre-tested strengths to answer any low headroom problem.

INNER CIRCLES®

Tunneliner Process allows passing of pipe through pipe underground without requiring excavations or disruption of surface traffic. Work progresses regardless of weather conditions.

Our technical staff will be pleased to assist you with your problems.

PROGRESS IN CONCRETE

Trade-Mark Reg. U.S. Pat. Off.

AMERICAN-MARIETTA COMPANY

CONCRETE PRODUCTS DIVISION

GENERAL OFFICES: AMERICAN-MARIETTA BUILDING, 101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS • PHONE WHITEHALL 4-5600

2 to 3 times

at no increased operating cost

With Westinghouse OV-35 Luminaires—first to be engineered and designed specifically for color-improved fluorescent mercury lamps!

Primary streets with old-fashioned incandescent lighting can now be properly lighted at high levels for little or no increased operating cost!

This is accomplished by Westinghouse developments that permit the OV-35 Luminaire to deliver *full* advantages of color-improved mercury lamps!

These mercury lamps give as much as *three times more light per watt* than old-fashioned incandescent sources. They also *outlast* old-style incandescent lamps by as much as seven times! And the OV-35 is the *only* luminaire engineered specifically for these superior mercury lamps!

The OV-35 features an exclusive sealed optical system that delivers greater illumination, with unparalleled efficiency, directly onto the roadway!

This OV-35 has a housing of cast aluminum—a special glass refractor of custom prismatic design!—and a reflector of Alzak-processed drawn aluminum!

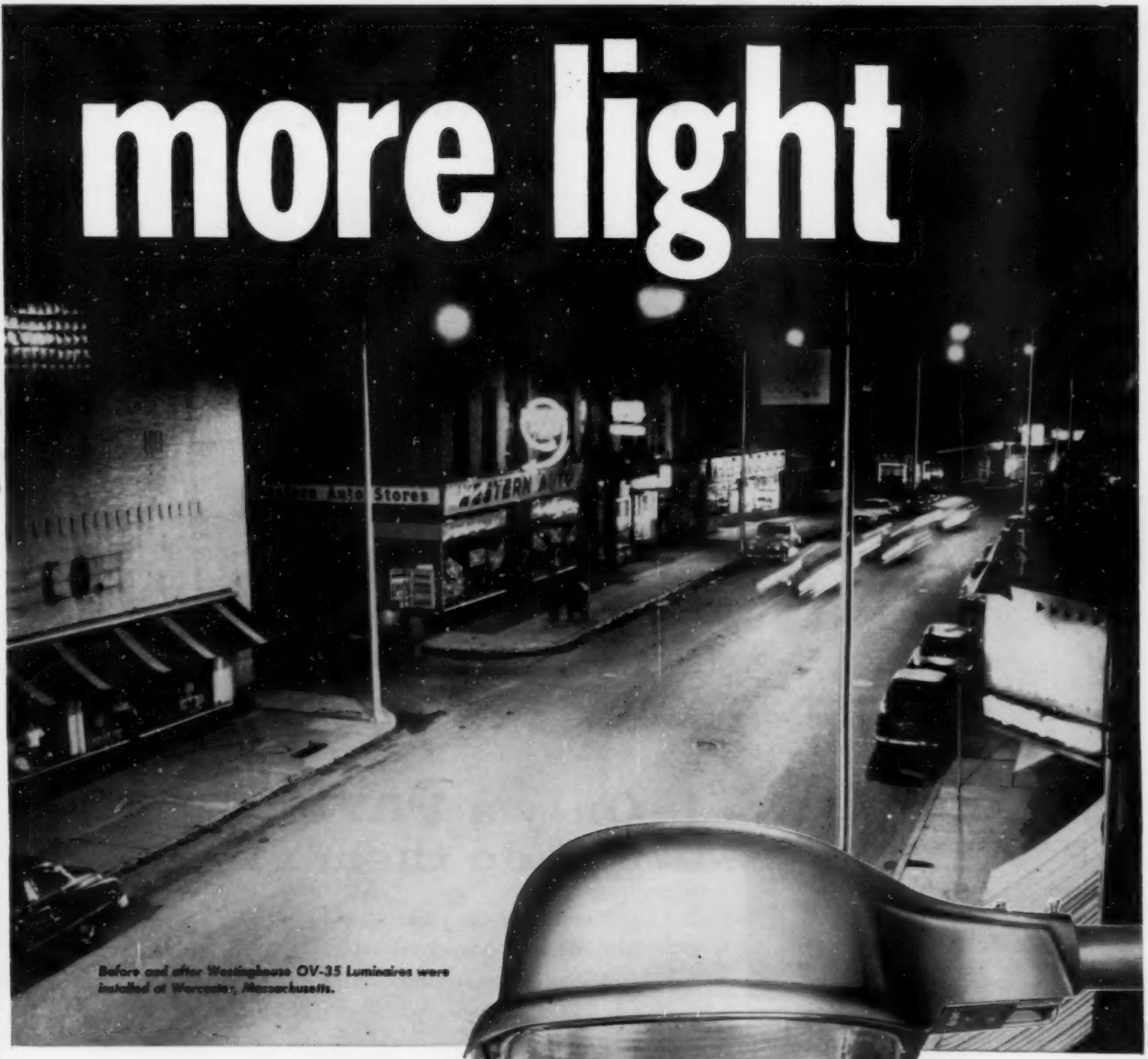
Its slip-fitter provides quick, easy mounting and adjustable alignment. Its automatic latch permits fast, "one-hand" maintenance. Yet the seal is tight on special gaskets. The Westinghouse OV-35 Luminaire is moisture-proof and bug-proof!

This OV-35 is accredited for many of the foremost advancements in modern mainstreet lighting today!

Westinghouse OV-10 now brings the same ideal illumination to residential streets!

The OV-10 delivers the same 2-to-3-times-more-light and the same extraordinary economy for the proper lighting levels of secondary streets! It has, in general,

more light



Before and after Westinghouse OV-35 Luminaires were installed at Worcester, Massachusetts.

the same marked design and construction superiorities of all Westinghouse street-lighting luminaires. One simple move of the socket gives a choice of light-distribution to suit illumination requirements for virtually *any* secondary street!

Accurate, forthright analysis of every street-lighting problem. Soundest recommendations at lowest practical cost!

Westinghouse makes optically superior luminaires—for every type of street-lighting application—that most effectively utilize every type of light source!

Your Westinghouse Lighting Engineer, therefore, recommends only the best possible luminaire for each street-lighting situation—consistent with the lowest practical costs.

Call your Westinghouse Representative, or write to Westinghouse Electric Corporation, LIGHTING DIVISION, Edgewater Park, Cleveland, Ohio. J-04454

YOU CAN BE SURE... IF IT'S

Westinghouse

a PAYLOADER® does them all!

Only a PAYLOADER® can do them all!

The rubber-tire tractor-shovel has won its wide popularity through exceptional versatility and flexibility. This natural usefulness and work-ability is being broadened by the development of new, quickly-interchangeable attachments.

Because "PAYLOADER" is the pioneer and leading line of rubber-tire tractor-shovels you can rightly expect that tested and proven attachments will first be available on the "PAYLOADER" line.

Two of the newest of these attachments, exclusive on "PAYLOADER", are the Ram Black-top Spreader and the Superior Side-boom — both practical and field-tested. Superiority in design, in proven features, in attachments and in Distributor service — all these make "PAYLOADER" the best investment in tractor-shovels for contractor, public body and material producer.

FREE BOOKLET

Shows action views and details of the many interchangeable attachments (including exclusive new ones) available for all sizes of 4-wheel-drive "PAYLOADER" tractor-shovels.

THE FRANK G. HOUGH CO.
701 Sunnyside Ave., Libertyville, Ill.

Send "PAYLOADER" 4-wheel-drive information as follows:

- ☐ Free *attachment* booklet
- ☐ Hough purchase and lease plans.
- ☐ model HO (9,000 lb. carry cap.)
- ☐ model HH (7,000 lb. carry cap.)
- ☐ model HU (5,000 lb. carry cap.)

Name _____

Title _____

Company _____

Street _____

City _____ State _____

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SAY "HUFF"

Modern Materials Handling Equipment

THE FRANK G. HOUGH CO.

LIBERTYVILLE, ILLINOIS

SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

MILLION-YEAR-OLD WONDER CHEMICAL HELPS

BERMICO®

Bituminized Fibre Pipe

Exceed Federal Specifications SS-P-356

From bituminous coal, formed by Nature millions of years ago, comes *coal tar pitch*—one of the wonder chemicals of today. On all types of outdoor structures, roads, roofs—wherever successful water and corrosion resistance is a *must*—there *coal tar pitch* has proved its lasting effectiveness.

Bermico, the tough cellulose fibre pipe, for house-to-septic tank or sewer connections, is thoroughly impregnated with *coal tar pitch.*

It exceeds Federal Government performance requirements for Water Absorption—Crushing Strength—Chemical and Kerosene Resistance—Hot Water Resistance—Heat Resistance—Resistance to Flattening—Beam Strength.

That's why more and more code authorities throughout the country are including Bermico bituminized fibre pipe in their codes.

Inquire about new full-color movie: "Modern Pipe For Modern Living." Write Dept. EB-5, Brown Company, 150 Causeway St., Boston 14, Mass. (Mills: Berlin, N. H.; Corvallis, Ore.)

BERMICO®
for house to sewer or septic tank
BERMISEPTIC®
for septic tank disposal fields

Guarantee of Quality BPI BITUMINOUS PIPE INSTITUTE

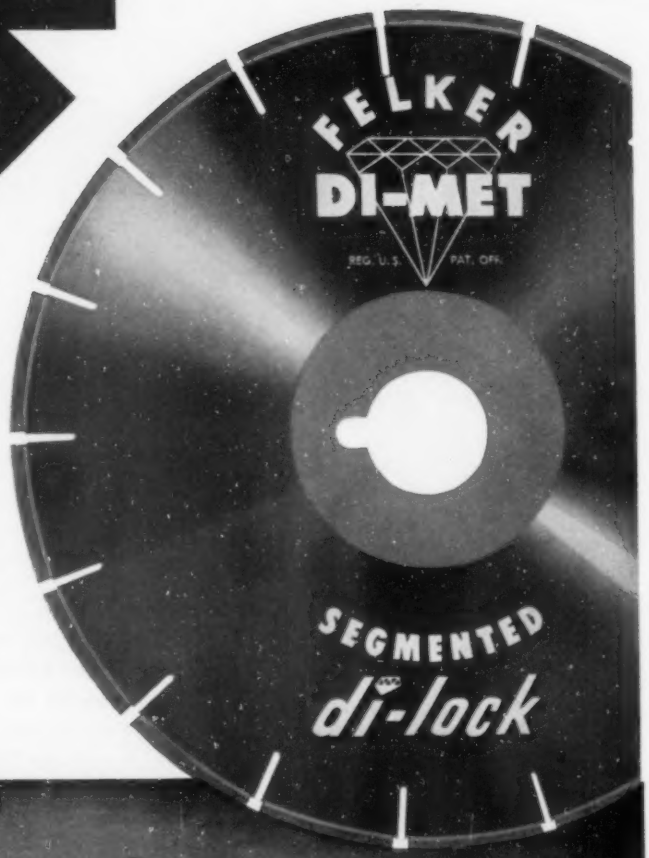
BEST GREEN CONCRETE BLADE YET!

In a recent test cutting 3 day concrete, one Felker DI-LOCK diamond blade cut a total of 8,000 feet 1" deep against 3,500 to 5,000 feet for competitive blades cutting to the same depth! Aggregate was gravel, flint and quartz. Blades were all operated on the same 36 h.p. concrete cutter and on the same job.

THIS IS ANOTHER TYPICAL CASE HISTORY OF DI-LOCK SUCCESS—

Reports keep pouring in from all over the nation with the same impressive facts... *more footage, faster cutting, greater economy per blade!* If you want lower cost per cut there's one *sure* answer proved by contractors from coast to coast! Specify Felker DI-LOCK'S, America's *longest-lived* diamond blade!

See your Felker Distributor or write for information.



Full line of Felker Concrete Cutting Machines! Illustrated: Felker Model 367-36 h.p.

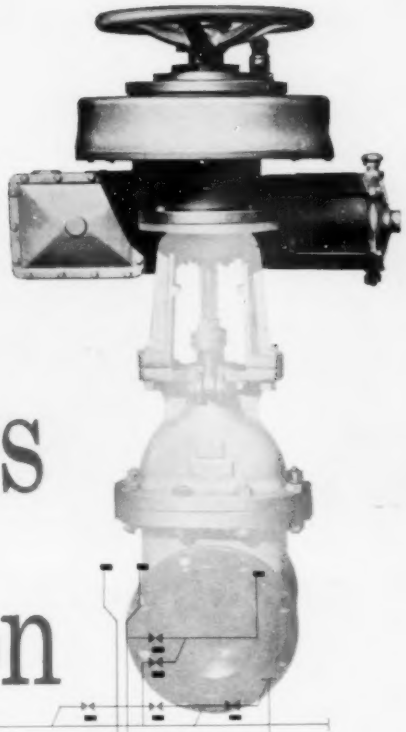
First in Diamond Cut-Off Blades!

FELKER DI-MET SINCE 1924

FELKER MANUFACTURING CO.

Torrance, California

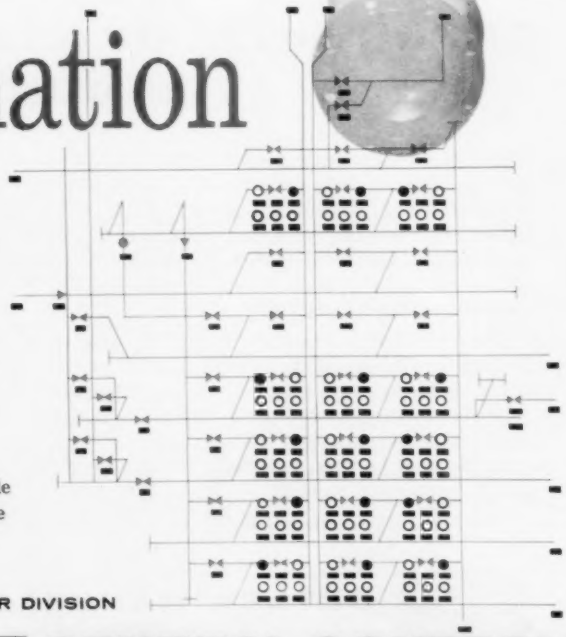
manual valves plus TORK-MASTER electric valve operators equal automation



TORK-MASTER makes *manual* valves *automatic!* Even more important, TORK-MASTER converts a manual operation to an automatic operation *without removing valves during changeover.*

And there's nothing complicated about this electric valve operator.

Its efficient, simple design assures you of low original cost, low maintenance cost and minimum circuitry to master control panel. You get complete flexibility in operation whether you go to total automation or merely wish to provide a limited remote control function. For case histories, full data on TORK-MASTER, write today to:



TORK-MASTER DIVISION

GENERAL CONTROLS

America's Finest Controls for Home, Industry, and the Military

Glendale, California • Skokie, Illinois • Guelph, Ontario, Canada

Six Plants—42 factory branch offices serving the United States and Canada

Butler County Highway garage building at Wyocena, Wisconsin

220-ft. long clear-span interior makes parking easy.

Big, wide doors are a standard Butler feature.

11,000 sq. ft. of wisely invested county highway funds

County and state money is well spent on Butler metal buildings. You get attractive, permanent cover that is head and shoulders, quality-wise, above other low-bid construction. You get completed buildings weeks to months ahead of conventional construction. And you get buildings that are more efficient for your needs.

These pictures show how Butler clear-span design provides 100% usable inside space. There is more room to move and store bulky road machinery. And you can see how Butler rigid-frame construction permits conversion of a whole wall to wide, overhead doors without special structural support.

What you can't see is the preliminary engineering that goes into Butler buildings to make them meet local codes and building laws—relieving your own staff of much routine engineering. Each metal part is precision die-formed for perfect fit, yet mass-produced in Butler factories to keep prices down. Faster, bolted assembly saves time and labor as well as materials.

Some State and County officials save even more time and money by standardizing on Butler buildings—ordering new construction like road machinery, virtually from their desks.

Call your nearby Butler Builder. He's under "Buildings" or "Steel Buildings" in the Yellow Pages of your phone book—invite him to bid on your next job.

See our catalog in Sweet's or write for copy

BUTLER STEEL PRODUCTS

BUTLER MANUFACTURING COMPANY

7321 East 13th Street, Kansas City 26, Missouri

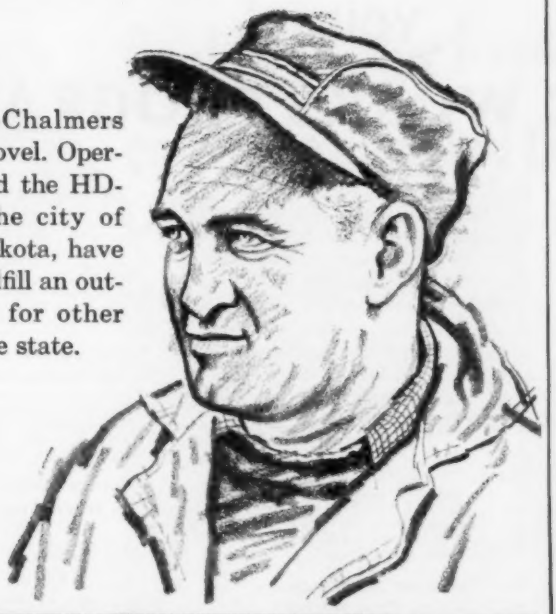
AISC

Manufacturers of Metal Buildings • Equipment for Farming, Dry Cleaning, Oil Production and Transportation, Outdoor Advertising • Custom Fabrication

Sales offices in Los Angeles and Richmond, Calif. • Houston, Texas • Birmingham, Ala. • Atlanta, Ga. • Kansas City, Mo. • Minneapolis, Minn. • Chicago, Ill. • Detroit, Mich. Cleveland, Ohio • Pittsburgh, Pa. • New York City and Syracuse, N. Y. • Boston, Mass. • Washington, D.C. • Burlington, Ontario, Canada

He maintains a model landfill

. . . with an Allis-Chalmers HD-11G tractor shovel. Operator **Don King** and the HD-11G, owned by the city of Mitchell, South Dakota, have made the city's landfill an outstanding example for other municipalities in the state.



HD-11G 32,000 lb weight • 2¼-cu yd bucket • 111 net engine hp

Mitchell landfill features deep, clean disposal

Two things impress observers at this landfill . . . the clean, sanitary appearance and the efficient handling of garbage . . . more than 30 truckloads daily. The man most responsible is Don King who operates the Allis-Chalmers HD-11G on the dump. Don puts a blanket of cover material over new fill every night to keep it in place. The 11-G's 32,000 pounds help compact garbage—make it airtight and vermin-proof.

Operator King likes HD-11G advantages on his kind of work. Its slim cowl and low lines make it easy for him to see as he spreads, compacts and covers. A comfortable seat, clear platform and responsive controls also help make the HD-11G an operator's machine.

Besides keeping a model fill area, it is also used to load 10-ton trucks with sand for street and road work. Average loading time for each truck—only 1¾ minutes.

An Allis-Chalmers tractor shovel in your town can give you the same efficient service.

ALLIS-CHALMERS
CONSTRUCTION MACHINERY DIVISION
MILWAUKEE 1, WISCONSIN

Look ahead . . . *move ahead* . . . and stay ahead with **ALLIS-CHALMERS**

EQUIPMENT and MATERIALS

FOR YOUR

PUBLIC WORKS PROGRAM

NEW LISTINGS

Literature on
Cushioned Float Valves

62. Cold or hot water pressure float valves and electric liquid level control valves are described in Bulletin W-5 available from Golden Anderson Valve Specialty Co., 1232 Ridge Ave., Pittsburgh 33, Pa. Specifications, list of parts and pressure drop charts for globe and angle valves are fully covered. Check the reply card today for this valuable bulletin.

Safety and Efficiency
With 3-Way Traffic Control

63. El-Tec radio interconnection enables cities to have complete traffic control in traffic programming, control originating with emergency vehicles and Civil Defense evacuation control. Check the reply card or write Electronic Protection Inc., 2085 North Hawthorne Ave., Melrose Park, Ill., for complete literature.

Armco Smooth-Flo
Sewer Pipe

86. High flow capacity, flexible strength, durability and wide size range of a corrugated metal pipe that is paved to the full periphery of the pipe are sections covered in bulletin from Armco Drainage & Metal Products, Inc., Middletown, Ohio. Check the reply card.

Steel Grating
& Stair Treads

120. Table of safe loads, general engineering data, stair tread data, spacing of bars, and other specifications of steel gratings are fully covered in a 16-page catalog from Kerrigan Iron Works, Inc., Nashville, Tennessee. Check the reply card for full details on how to specify and design for steel gratings and standard anti-slip and close spaced anti-slip stair tread today.

Complete Catalog on
Masonry Drilling Equipment

199. Masonry drills, diamond bits and core barrels, core retrievers and water removal equipment are covered in catalog from Pennsylvania Drilling Co., Masonry Drill Div., 1201 Banksville Rd., Pittsburgh 16, Pa. Check the reply card for types and price list.

Diesel Powered
Crawler Tractor

92. A 14-page catalog (MS-1251) from the Construction Machinery Div., Allis Chalmers Mfg. Co., Milwaukee, Wisc., covers the HD-6 diesel powered crawler tractor. Check the reply card for graphs and charts, catalog views of the tractor's principal components and a cutaway view of the entire tractor.

Darling Aluminum Gate
Valves and Check Valves

99. Specifications and dimensions of Darling aluminum gate valves and check valves are covered in literature from Darling Valve & Mfg. Co., Williamsport, Pennsylvania. Check the reply card.

The engineering information in these helpful catalogs will aid you in your Engineering and Public Works programs. Just circle numbers you want on the reply card, sign and mail. This free Readers' Service is restricted to those actively engaged in the public works field of cities, counties or states.

Data on
Portable Water Coolers

74. Standard water cans and standard water coolers and heavy duty water coolers of several sizes and types are covered in literature from Schlueter Mfg. Co., St. Louis 7, Mo. Check the reply card today.

Bare Pavement Maintenance
With Sterling Rock Salt

84. Handbook is designed for road maintenance men who are responsible for safe winter pavements; and is a safe-roads fact book about a modern snow and ice removal program. Check the reply card or write International Salt Co., Inc., Scranton, Pa.

Self-Propelled, One Man
Operated Hydra-Hammer

85. This unit breaks concrete pavement, tamps backfill, tamps rock or heavy aggregate, cuts asphalt, compacts blacktop patches and drives highway guard rail posts. Check the reply card or write Ottawa Steel Div., Young Spring and Wire Corp., Ottawa, Kans., for complete literature.

MORE LISTINGS ON PAGES 36 TO 54

Sparjer-Aerobic Package
Sewage Treatment Plants

102. Bulletin 26-S-92 gives full details on the Walker Process Sparjer-Aerobic process package sewage treatment plants. Plant completely treats the sewage and sludge. Copies of bulletin are available from Walker Process Equipment, Inc., P. O. Box 266, Aurora, Ill., or check the reply card.

Handbook on How to
Lay Concrete Pressure Pipe

103. Manual on concrete pipe laying instructions is available from Price Brothers Co., Dayton, Ohio. Check the reply card for information on how to dig the trench and handle the pipe, make the joint and the pipe bedding procedure.

Right Angle Gear
Drive For Centrifugal Pumps

107. Applications, gear drive selection tables, pulley data, efficiencies and standard dimensions of Johnson right angle gear drives are covered in catalog from Johnson Gear & Mfg. Co., Ltd., Eighth and Parker Sts., Berkeley 10, Calif. Check the reply card.

Buckets and Grapples
For Incinerator Service

110. Bulletin provides comprehensive information on the 5 sizes of 2-line, lever arm, clamshell-type buckets; standard 2-line, tine-type grapples; equalizer arrangements and certain incinerator buckets for single drum hoists. Check the reply card or write Blaw-Knox Co., 300 Sixth Ave., Pittsburgh, Pa., today.

Preload Concrete Tanks
For Sewage Treatment Tanks

113. Concrete tanks for sludge digesters, clarifiers, flocculators and thickeners are covered in literature from The Preload Co., Inc., 211 East 37th St., New York, N. Y. Check the reply card for full design data.

Service Saddles Used
in Water Line Connections

114. Service saddles from M. B. Skinner are rugged malleable iron construction, with a full length hinge on one side and single extra-oversize plated bolt on the other. Write M. B. Skinner Co., South Bend, Ind., or check the reply card for literature.

Manual on Highway Railings
For Bridges and Roadways

115. This manual covers design suggestions, components, specifications for design and construction and the advantages of Alcoa aluminum alloy highway railings. Check the reply card or write Aluminum Company of America, Alcoa Bldg., Pittsburgh 19, Pa., for this valuable manual.

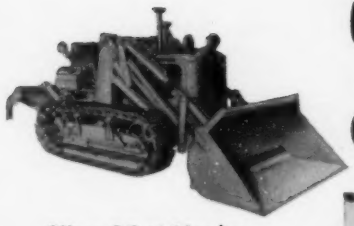
ABC's of Soil-
Cement Stabilization

116. Colorful 36-page handbook is fully illustrated, easy to read treatment of every practical aspect of soil cement stabilization as related to street, highway, super-highway, parking lot and airport construction. Check the reply card or write Pettibone Wood Mfg. Co., Box 620, 6902 Tujunga Ave., No. Hollywood, Calif., for complete information.

Literature on
Wet Classification

121. This 24-page catalog consists of 24-pages of information on the construction and application of the Hardinge Counter-Current Classifier, Heavy Media Separator, Hydro-Classifier and Hydro-Separator plus combined grinding and wet classifying flow sheets. Write Hardinge Co., Inc., 240 Arch St., York, Penna., or check the reply card.

"Our one OLIVER OC-126 Loader handles our complete sanitary landfill operation"



Oliver OC-126 loader

"It is the ideal machine for this operation. It digs the trenches, spreads and compacts the refuse, and covers—doing all these jobs just like it was made specially for this work. Its low operating and maintenance costs continually amaze us."

Calvin F. Ellis, Supt. of Public Works, Moorestown, New Jersey, directs a sanitary landfill that's so efficient public officials have come from a wide area to inspect it.

With just one Oliver OC-126 loader, they handle all functions of sanitary landfill for a population of 13,000 and numerous industries.

In your sanitary landfill, too, you'll benefit more from Oliver's high-clearance design with fully protected crawlers and rapid bucket action. It's the most capable loader in the 1½-yard size! See your Oliver distributor.

FREE! Newest Service Bulletin on Sanitary Landfill

The most up-to-date guide with helpful data, step-by-step pictures, complete explanation. Mail coupon.

THE OLIVER CORPORATION

Industrial Division, 19300 Euclid Ave., Cleveland 17, Ohio

a complete line of industrial wheel and crawler tractors and matched allied equipment

For effective pest control —the Oliver Mist Sprayer

You can have positive, low-cost control of bugs, flies, mosquitoes and Dutch elm disease. The Oliver Model 125 mist sprayer has a powerful, concentrated spray stream that permits spraying large areas faster, better and with more lasting results. Mail coupon.

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The Oliver Corporation
19300 Euclid Ave., Cleveland 17, Ohio

Send me your new sanitary landfill bulletin.

_____ Also supply literature on the Oliver mist sprayer.

*Name*_____
(Please Print)

*Title*_____

*Address*_____

*Town*_____ *Zone*____ *State*_____

To order these helpful booklets check the reply card opposite page 54.

NEW LISTINGS (Cont.)

Up-Sewer Treatment
Controls Odors

129. Controlling sulfide production and the activity of odor-producing organisms by applying Cloroben at selected manholes, and at sewage treatment plants is described in a folder for your file cabinet. Write Cloroben Chemical Corp., 115 Jacobus Ave., South Kearney, N. J. or check the reply card.

Float-Treat System
For Water and Sewage Treatment

149. Float-Treat system is a process in which suspended organic matter and usual chemical flocs are removed from process liquids by flotation. Flow diagrams, advantages, applications and schematic drawings are covered. Write Chain Belt Co., Milwaukee 1, Wisc., or check the reply card today.

All-Purpose Wheel Tractors
For Maintenance and Construction

155. Oliver industrial wheel tractors are described in literature from The Oliver Corp., 400 West Madison St., Chicago 6, Ill. Check the reply card today.

Technical Data on V-Notch
Variable-Orifice Chlorinator

152. The Series A-731 chlorinator is adaptable to any type of chlorinator control and provides wide range adjustment and excellent reproducibility of chlorine flow. Check the reply card or write to Wallace & Tiernan Inc., 25 Main St., Belleville 9, N. J., for design features, flow diagrams and operation data.

Non-Electric
Traffic Control Products

156. Reflective pavement marking glass beads, Cataflex "202" reflective coating, Cataline reflective striping, Catatherm reflective plastic striping, plain and reflective street and highway signs, plain and reflective street name signs are covered in literature from Cataphote, Corp., P. O. Box 2066, Jackson, Miss., or by checking the reply card.

Incinerator Plants
For the Modern Municipality

141. A 20-page catalog that discusses the municipal refuse disposal problem and states the basic requirements of satisfactory incineration is available from Pittsburgh-Des Moines Steel Co., 3432 Neville Island, Pittsburgh 25, Pa.

Reflective Liquid For Hydrants,
Guard Rails and Culvert Walls

157. Codit reflective liquid goes on fast by brush or spray and lasts up to 2 years. Hazards flash their own bright warning at night for safety. Check the reply card or write Minnesota Mining & Mfg. Co., Dept. NR-58, St. Paul 6, Minn., for full information.

Incinerator Maintenance
Can Be Cut!

159. There are no joints in a Plibrico lining and the lining has a positive anchorage system holding it securely in place. The stoker provides automatic ash discharge, and works as a single unit. For complete details on cutting incinerator maintenance write Plibrico Incinerators, 1800 Kingsbury St., Chicago 14, Ill.

Submersible Electric Pumps
For Dewatering Problems

167. Pumps range in size from 1½"-85 gpm capacity to 8"-300 gpm capacity, with head capacities up to 210 ft. Write to Stanco Mfg. & Sales Inc., 1666 Ninth St. (Corner of Olympic & Ninth), Santa Monica, Calif.

Bituminized Fibre Pipe
For Sewer Connections

172. Bermico pipe for house to sewer or house to septic tank connections is described in literature from Brown Co., 150 Causeway St., Boston 14, Mass. Check the reply card for full details.

Sand and Cinder Spreaders
For Streets and Highways

175. PTO with mechanical or hydraulic operation and auxiliary engine with mechanical or hydraulic operation are the choice of drives on these sand and cinder spreaders. Check the reply card or write Baughman Mfg. Co., 152 Shipman Road, Jerseyville, Ill., for complete catalog.

Fork Lift
For Utility Tractors

176. Tractor fork lift is designed for materials handling on construction and maintenance jobs. Literature is available from Henry Mfg. Co., Inc., Topeka, Kans., or by checking the reply card.

Catalog on Soil
Testing Equipment

181. The TESTlab Corp., 250 W. 57th St., New York 19, N. Y., has a general catalog on equipment for soil testing in the field and in the laboratory. Check the reply card.

Core Drills and
Soil Sampling Equipment

188. Diamond drill machines, Oriented diamond bits, soil sampling equipment and core drilling accessory equipment are fully covered in well illustrated catalog from Sprague & Henwood, Inc., Scranton 2, Pa. Check the reply card.

Tubular Conveyors Move
Almost Any Flowable Material

190. Covered in this catalog on Hapman conveyors are a general description, materials handled, installations, design details, charts on weight-volume-time and capacities and applications. Check the reply card or write Stuart Corp., 516 No. Charles St., Baltimore, Md., for catalog.

Accuracy In
Chemical Proportioning

191. For chlorinating swimming pools or drinking water, for feeding polyphosphates, fluorides, soda ash, alum, or acids in water treatment where precise accuracy is required, consult the literature of Precision Chemical Pump Corp., 1396 Main St., Waltham 54, Mass.

Heavy Duty Swimming Pool
Equipment for Municipal Pools

193. Illustrated bulletin showing heavily built diving and deck equipment is available from American Playground Device Co., Anderson, Ind. Check the reply card for specifications on diving boards, data on diving stands, towers, slides, pool ladders and pool cleaning equipment.

Proper bucket or grapple headroom allowances mean more efficient incinerator operation

Planning and making allowances for necessary headroom over the hoppers insures better operation of your incinerator. Loose refuse hanging below the bucket or grapple will not be knocked off, with the resulting necessity of manual clean-up time.

Blaw-Knox engineers are available to assist you in planning, selecting and applying Clamshell Buckets and Tine Type Grapples especially developed and built for incinerator service. They'll be glad to lend their experience and guidance toward the best solution of your incinerator handling problems.

BLAW-KNOX COMPANY
Blaw-Knox Equipment Division
Pittsburgh 38, Pennsylvania

BLAW-KNOX

WRITE TODAY for a copy bulletin 2350R-1. It's brand new, contains much helpful information on designing for efficient handling practices.

Ted W. Brown, Secretary of State of Ohio, checking the Recordak Microfilm operation he has instituted in the Corporation Department

Received...processed...returned the same day!

Corporation records filed with the Secretary of State's office in Ohio now handled faster at a saving of $27,000 per year with Recordak Microfilming.

Picture-taking is making some big changes in the Office of the Secretary of State of Ohio!

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Learn more about Recordak Microfilming. Prices start at a low $550 for the Recordak Junior Microfilmer with built-in film reader! Also available on a low-cost monthly rental plan. Mail coupon today.

Prices quoted subject to change without notice.

RECORDAK

(Subsidiary of Eastman Kodak Company)

originator of modern microfilming—
now in its 30th year.

"Recordak" is a trademark

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Gentlemen: Please have a representative contact me on the use of Recordak Microfilming in government agencies. Z-5

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Agency_____

Street_____

City_____ State_____

To order these helpful booklets check the reply card opposite page 54.

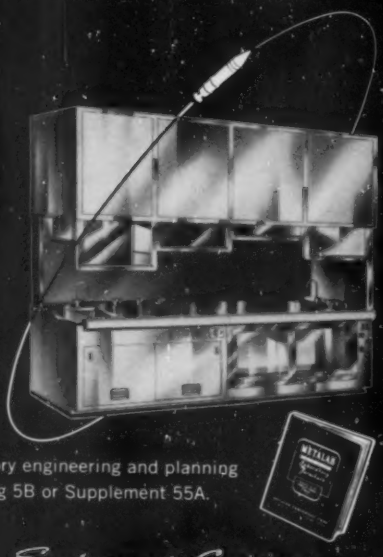
METALAB

PROGRESS IS MADE IN METALAB EQUIPPED LABORATORIES

History shows that a lack of laboratory facilities has hindered scientific progress.

While scientific theories are essential, there is no substitute for actual laboratory research and experimentation.

Metalab manufactures a complete line of METAL or WOOD laboratory equipment including: chemical fume hoods, and fume hoods for radioactive materials, storage cabinets and cases, center and wall tables, sinks, and specialized units for any requirements you may have for your laboratory.



Write for information about our laboratory engineering and planning service. Also—send for 180-page Catalog 5B or Supplement 55A.

METALAB *Equipment Company*

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238 DUFFY AVE., HICKSVILLE, LONG ISLAND, NEW YORK

Above ground structures are no longer necessary

modernize!

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ZF PREFABRICATED PUMPING STATIONS

THIS IS THE STATION THAT IS PREFABRICATED AND DELIVERED TO JOB SITE READY TO OPERATE

DESIGNED TO AUTOMATICALLY HANDLE RESIDENTIAL, INDUSTRIAL AND COMMERCIAL WASTES

COMPLETE DATA, SPECIFICATIONS AND DRAWINGS AVAILABLE—WRITE

ZIMMER & FRANCESCON P. O. BOX 359, MOLINE, ILLINOIS

WATER WORKS

Equipment For Water, Sewage and Industrial Waste Treatment

24. The complete line of Jeffrey equipment for treatment plants is covered in a 66-page Catalog 905 available from The Jeffrey Mfg. Co., Columbus 16, Ohio. Check the reply card for information on bar and disc type screens, traveling water screens, grinders, grit collectors, garbage grinders, sludge, draw-off valves, chemical feeders, bucket elevators and scum removers to mention some of the equipment.

Ball and Socket River Crossing Cast Iron Pipe

33. Literature is available describing Clow ball and socket cast iron pipe for river crossing, or any installation where full 15 degree free turning deflection is desirable. For full description and specifications, address James B. Clow & Sons, Inc., P. O. Box 6600-A, Chicago 80, Ill., or check the reply card.

Plastic Wash Troughs For Water Treatment

45. Leopold fiberglass-reinforced plastic wash troughs for water treatment are described in literature from F. B. Leopold Co., Zelienople, Pa. Check the reply card for data on these units that will last for years without any painting or other maintenance.

Meter Features That Help Make Water Works Profitable

59. Simple design, accuracy and long life, moderate first cost and inexpensive maintenance are features of American Water meters described in Bulletin No. 56 of the Buffalo Meter Co., 2917 Main St., Buffalo 14, N. Y. Be sure you have this informative booklet which gives the details of American meter design and construction plus full data on sizes, capacities and dimensions. Check the reply card.

Valuable Bulletin on Rodney Hunt Sluice Gate

61. Sluice gate seats on a resilient rubber seal flush with the bottom of the channel and eliminates bottom wedges and the trough in which they descend. Gives design flexibility in water filtration, sewage treatment and sluices, dam, channel and chamber flow control. For complete details write to Rodney Hunt Machine Co., 82 Lake Street, Orange, Mass. for Bulletin 75, or check the reply card.

Easily Cleaned Long Run Filter Bed Media

70. Bulletins on Anthrafilt tell the reasons why selected, graded crushed anthracite is superior to sand as a filtering material. Have you made a full investigation? Write Anthracite Equipment Corp., Wilkes-Barre, Pa.

100 Page Book Helps Solve Water Problems

71. pH and Chlorine Control. A discussion of pH, Chlorine and Phosphate Control and descriptions of comparators for making colorimetric analyses. A 100 page booklet is available by checking reply card. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

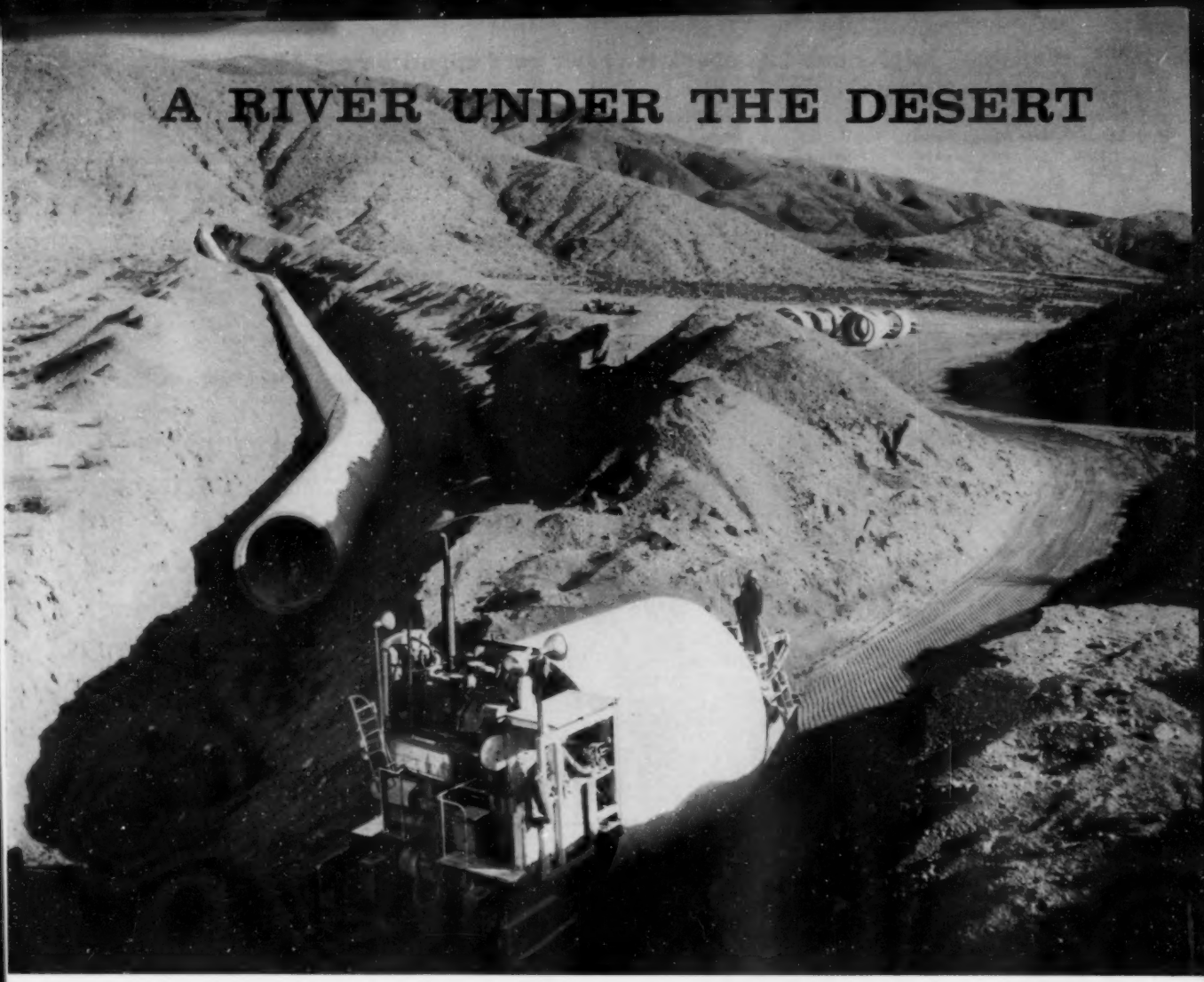
Selection and Application Handbook on Comminutors

79. Included in this handbook is a description of Worthington's comminutor line covering its features, dimensions and other information necessary for correct selection and application. Check the reply card or write Worthington Corp., Advertising and Sales Promotion Dept., Harrison, N. J., for Handbook #W-317-B17AP.

Rapid Sand and Pressure Filter Data

109. Rapid sand filters. A complete line of vertical and horizontal pressure filters, wooden gravity filters, and filter tables and other equipment. For engineering data, write Roberts Filter Manufacturing Co., 640 Columbia Ave., Darby, Pa., or check the reply card.

A RIVER UNDER THE DESERT



American Pipe and Construction Co. is engaged in the manufacture and installation of 63,000 ft. of reinforced concrete pipe for 47 inverted siphons of the Colorado River Aqueduct. The siphons, widely spaced along a 183-mile segment of the aqueduct, are part of the program of the Metropolitan Water District of Southern California to bring the gigantic water supply line to full planned delivery capacity of over a billion gallons of water per day.

American's solutions to the remote location and magnitude of the project include the establishment of two on-the-project manufacturing plants. Hauling of 13 ft. 6 in. diameter 68-ton sections of pipe is being accomplished with specially designed 99 ft. trailer-rigs. Approximately 180 miles of access roads are to be constructed before the job is completed in December, 1958. American designed and built the machine shown above to meet special installation problems posed by trenches 125 ft. wide and 50 ft. deep, with slopes up to 50%. This unique "Pipe-mobile" actually carries and installs the pipe.

Today, American Pipe and Construction Co. is more than ever capable of handling problems involved in long-distance transmission of large volumes of water. Fifty years of experience and extensive production facilities are available to help solve any water supply or transmission problem.

American
PIPE AND CONSTRUCTION CO.

Los Angeles: 4635 Firestone Blvd., South Gate, Calif.
LOrain 4-2511
Hayward: P.O. Box 630—JEfferson 7-2072
San Diego: P.O. Box 13—CYpress 6-6166
Phoenix: 2025 South 7th St.—ALpine 2-1413
Portland: 518 N.E. Columbia Blvd.—BUtler 5-2531

Project plants, such as this one located near Desert Hot Springs, California, incorporate all essential manufacturing operations of permanent plants and bring greater economy and coordination to such large projects.

CONCRETE PIPE FOR MAIN WATER SUPPLY LINES, STORM AND SANITARY SEWERS, SUBAQUEOUS LINES

To order these helpful booklets check the reply card opposite page 54.

Information on Service, Valve, Roadway and Meter Boxes

122. Literature on specifications covering "Buffalo" service, valve, roadway and meter boxes, and adjustable valve boxes for water and gas has just been released from Buffalo Pipe & Foundry Corp, Box 55-Station B, Buffalo 7, N. Y. Check the reply card for your information on these valve boxes.

Protective Lining for Concrete Pipe and Structures

131. T-Lock Amer-Plate is a tough, long-lasting acid-resistant vinyl sheet lining for concrete pipe and structures which are exposed to corrosive materials. T-shaped ribs pressed in the sheet are embedded in the concrete as it is poured to lock the lining permanently in place. Get full details from Amercoat Corp., South Gate, Calif., or check the reply card for illustrated folder.

Engineering Data on Diatomite Filters

139. Get complete data on the Sparkler model SC-J diatomite slurry feed filter for swimming pools from the Sparkler Mfg. Co., Mundelein, Ill. Check the reply card for full information including table of filter sizes and capacities, space required and filter operation.

Now Every Municipality Can Own a Trencher

173. The low cost of the Blackhawk Trench Hog, a tractor-mounted ladder type trencher makes it profitable for many municipalities to own their own trencher. Be sure to investigate this versatile machine which digs trenches to 7 feet deep, 20 inches wide. Illustrated bulletin available from Arps Corp., New Holstein, Wis. Just check the reply card.

Engineering Data On Mechanical Joint C.I. Pipe

183. General specification, weights and dimensions of mechanical joint cast iron pipe and fittings are furnished in a 32-page booklet issued by Alabama Pipe Co., Anniston, Ala. Get this helpful data by checking reply card.

Helpful Reference Catalog on Waterworks Gate Valves

146. All necessary details on Double Disc Parallel Seat Gate Valves for waterworks use are provided in the attractive 36-page bulletin issued by Ludlow Valve Mfg. Co., Inc., Troy, N. Y. Conveniently arranged design data shows all dimensions for 2" to 60" valves. Gearing, floor stands, operating devices are covered too. Get Bulletin 54W by checking the reply card.

A Short Course In Pipe Jointing

169. The story of rubber couplings for clay and concrete pipelines is graphically presented in the booklet "Pipe Enterprise", published by Hamilton Kent Mfg. Co., Kent, Ohio. Detailed description of pipe jointing methods; photos showing jobs where Tylox gaskets met the need for easily assembled permanently tight joints installed under all conditions; and a report on the development, manufacture and outstanding features of the compression type gasket make this booklet valuable to every engineer and contractor. Check the reply card.

Complete Catalog and Reference Data on Valves and Fittings

211. The entire M & H line of valves, fittings and accessories for water works, filtration, sewage disposal and fire protection are illustrated and fully detailed in Catalog 52 issued by M & H Valve & Fittings Co., Anniston, Ala. In addition to complete data on these products, there are many pages devoted to helpful engineering data. Every designer should have a copy.

Manual on Pipe Finding Techniques

213. A manual on special pipe finding and leak detecting techniques of interest to utilities, municipalities, oil and gas companies is announced by Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, Calif. The manual contains a number of articles on locating buried pipes and cables and detecting and locating fluid leaks in pipe lines. Check the reply card for your free copy.

Catalog on Dewatering Pumps

226. Centrifugal and diaphragm pumps for dewatering jobs are described in Catalog DP7 from The Jaeger Machine Co., 550 West Spring St., Columbus 16, O. Models, specifications and performance tables are included. Check the reply card.

Mueller Copper Water Meter Yokes

242. Copper meter yoke provides a tailor-made setting with fewer joints and fittings and it permits the installation of service lines without placing the meter. Check the reply card or write Mueller Co., Decatur, Ill., for complete information.

Water Lines Under Pavements Easily Installed

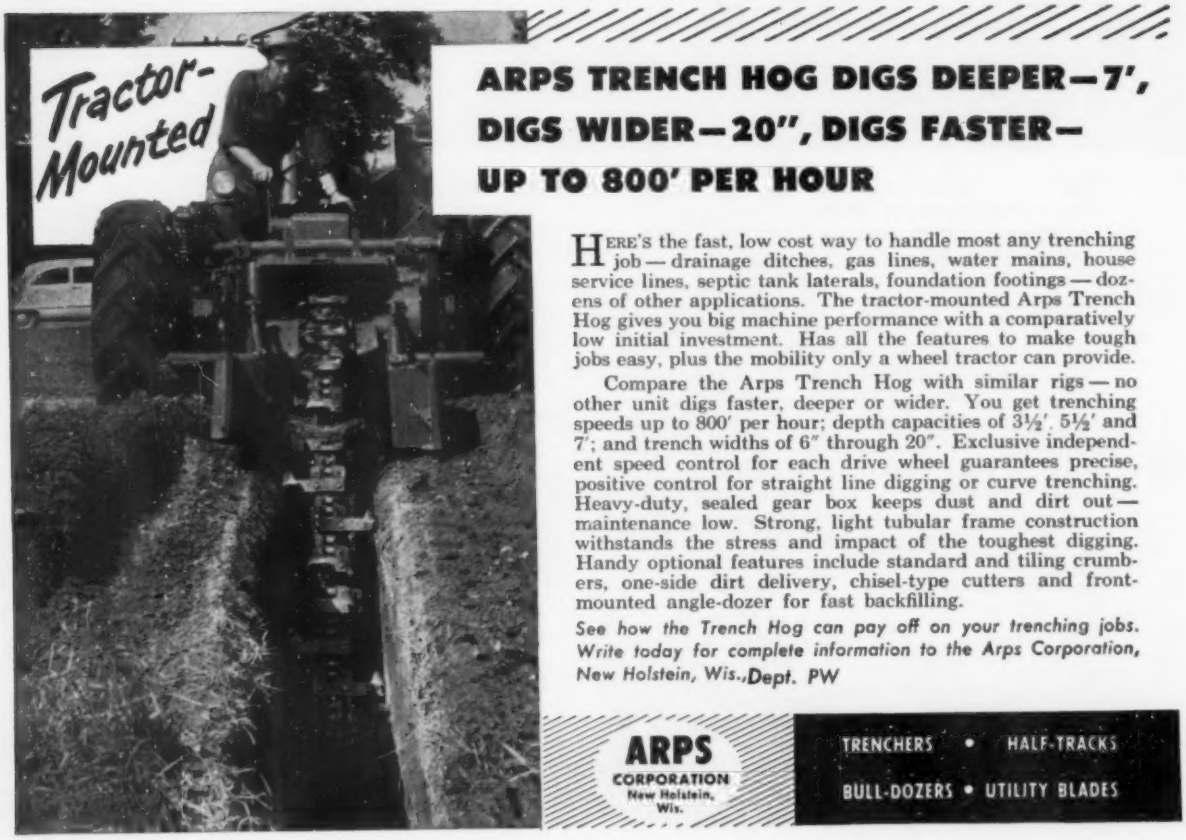
247. With a Trojan pipe pusher and puller no resetting of grip is required, so the work goes twice as fast. Two models, for pipe up to 2" dia. The larger model is available with air power unit to eliminate manual pushing. Get full details by checking the reply card. Trojan Mfg. Co., 1114 Race Dr., Troy, Ohio.

Review of Diatomite Filtration of Water

285. A detailed review of the application of diatomite in the general field of water filtration, including uses in municipal supply and swimming pools is contained in a well-prepared 16-page bulletin. Specific applications to certain water treatment problems are also discussed. Write to the Dicalite Department, 612 So. Flower St., Los Angeles 17, Calif. for Bulletin BW-13 entitled, "Diatomite Filtration of Potable Water," or check the reply card.

Manual on the Hersey Disc Water Meter

329. Illustrations, descriptions and specifications of Hersey water meters are covered in manual available from Hersey Mfg. Co., 250 Elm St., Dedham, Mass. Size ranges are ⅝"-¾"x¾"-¾" and 1". Check the reply card.



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HERE'S the fast, low cost way to handle most any trenching job — drainage ditches, gas lines, water mains, house service lines, septic tank laterals, foundation footings — dozens of other applications. The tractor-mounted Arps Trench Hog gives you big machine performance with a comparatively low initial investment. Has all the features to make tough jobs easy, plus the mobility only a wheel tractor can provide.

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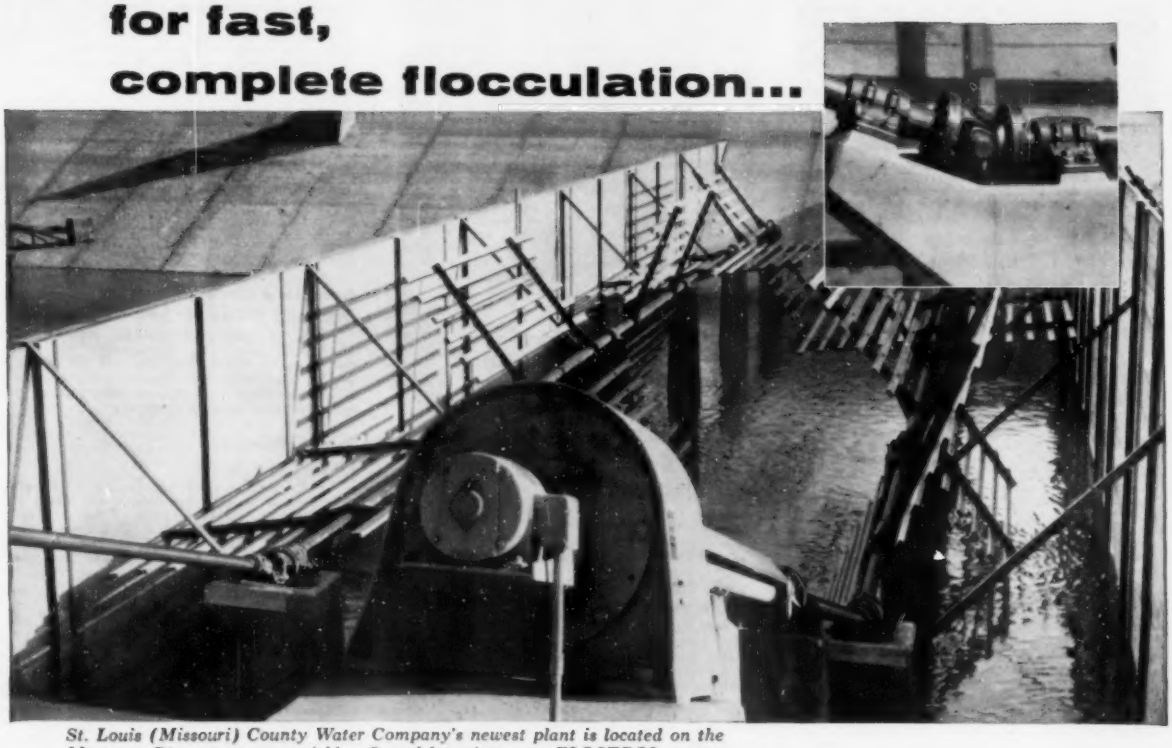

St. Louis (Missouri) County Water Company's newest plant is located on the Meramac River, a stream quickly affected by rainstorms. FLOCTROL system provides fast, thorough, lower-cost clarification in this efficient 15 mgd. plant.

minimum chemical dosage, 30% smaller basins

Jeffrey FLOCTROL systems clarify water, sewage and industrial wastes efficiently and at lower cost:

PROVEN DESIGN—Decreasing rates of agitation and increasing time periods as flocculation progresses insure fast, thorough diffusion of chemicals and complete coagulation.

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Jeffrey FLOCTROLS are available in standard horizontal type . . . special horizontal type for use where rapid mixing takes place in a separate basin . . . vertical type for smaller locations where indicated. Catalog 905 describes these and other Jeffrey equipment for water, sewage and industrial waste treatment. The Jeffrey Manufacturing Company, 947 North Fourth Street, Columbus 16, Ohio.

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TRANSMISSION MACHINERY...CONTRACT MANUFACTURING

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To order these helpful booklets check the reply card opposite page 54.

Points to Consider in Filter Sand Selection

332. Best operation of rapid sand filters requires filter media which is hard, properly shaped, carefully graded and perfectly clean. Filter sand and gravel which meets these exacting requirements is available on short notice from Northern Gravel Company, Box 307, Muscatine, Iowa.

Diesel Engines For Municipal Power Needs

359. Dependable power for water supply or flood control pumping stations, stationary or portable electric plants and many other municipal needs can be provided by engines described in literature of the Enterprise Engine & Machinery Co., 18th & Florida Sts., San Francisco 10, Calif.

How Your Filter Washing Can Be Improved

368. More effective sand washing with elimination of mud balls and bed cracking with resultant longer filter runs are claimed for the Palmer Filter Red Agitator, described in bulletins issued by Palmer Filter Equipment Co., Erie, Pa. Check the reply card.

Here's Help for Laboratory Planning

369. A comprehensive laboratory planning guide that tells the engineer and designer how to obtain maximum space economy; utilize new and present facilities; and use functional design in locating utilities, ventilation and lighting is now available from Metalab Equipment Co., Hicksville, L. I., N. Y. Complete data includes sectional and interchangeable lab equipment, furniture and accessories. Check the reply card for this valuable planning aid.

What You Should Know About Hypochlorination

395. "Hypochlorination of Water" is the name of an informative publication issued by Olin Mathieson Chemical Corp., Industrial Chemicals Div., Baltimore 3, Md. In it there is a discussion of chlorination theory, practice and equipment; control of algae, tastes and odors; and laboratory testing.

Swimming Pool Data Book

373. A 52-page book, profusely illustrated, containing data, photographs and prices of every item needed to build a new residential or public pool, or to equip and maintain an existing pool is now available. There is a section on proper pool care and maintenance and detailed descriptions of approved water treatment chemicals. Book is available by checking the reply card or writing to Modern Swimming Pool Co., Inc., 1 Holland Ave., White Plains, New York.

Welded Steel Pipe from 6 to 10 3/4" Diameter

382. High grade butt welded light-weight steel pipe from 8 to 16-gauge in 20, 30 and 40-foot lengths, plain or asphalt coated, with choice of joints. Also available up to 0.188 wall. Check uses for municipal water lines, irrigation, well casings and many other applications. Self explanatory literature from Valley Mfg. Co., Valley, Nebraska.

Use The Reply Card

Cleaning and Relining Water Pipe the Easy Way

397. Complete facilities for relining cast iron or steel water pipelines in place from 4" to 144" in diameter, with the Spunline (TM), Tate and Centriline Processes offered by Pipe Linings, 2414 E. 223rd St., Wilmington, Calif. For full information on cleaning and relining pipe with only momentary interruption of service, check the reply card.

What You Should Know About Venturi Tubes and Nozzles

400. A comprehensive bulletin, No. 100, of interest to all engineers dealing with the measurement of liquid flow and its various ramifications has been issued by Simplex Valve & Meter Company, Lancaster, Pa. Data on advantages, construction and installation details, range of sizes and specifications are given in simplified form.

How to Choose the Right Self-Priming Centrifugal Pump

427. Descriptive folders on the complete line of contractors' pumps have been issued by the Gorman-Rupp Co., Mansfield, Ohio. 2-in. to 10-in models are illustrated, performance tables are shown and pump selection tables are included to assist in choosing the proper pump for different jobs.

Important Factors in Water Meter Selection

463. Interchangeability of parts is an important advantage that is yours when you use Trident meters. The newest parts fit your oldest Tridents so you modernize when you repair. Get full data on the entire Trident water meter line by checking the reply card or write to Neptune Meter Co., 19 West 50th St., New York 20, N. Y.

Data on Adjustable-Speed Magnetic Drives for Low-Lift Pumps

465. A catalog is available from Electric Machinery Mfg. Co., Minneapolis 13, Minn. that tells all about E-M Vertical Synchronous Motors and Magnetic Drive Units. Engineers check the reply card for information on this equipment for sewage pumps.

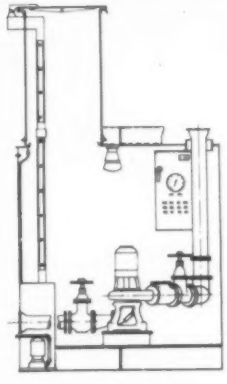
Plastic Pipe For Liquids and Gases

514. Kraloy rigid polyvinyl chloride plastic pipe can be used for liquids and gases and will not rust, rot or corrode. Write to Kraloy Plastic Pipe Co., 4720 E. Washington Blvd., Los Angeles, Calif., or check the reply card for complete details on this lightweight pipe.

Modern Elevated Water Tanks

566. A 16-page bulletin describing 2 types of water storage tanks, the watersphere and the waterspheroid, is available from the Chicago Bridge & Iron Co., 332 South Michigan Ave., Chicago 4, Ill. Standard sizes from 25,000 gals. to 500,000 gals. are covered. Check the reply card.

Schmieg AUTOMATIC UNDERGROUND PUMPING STATIONS



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To order these helpful booklets check the reply card opposite page 54.

Motor Valves Have Versatile Application

485. The General Controls Hydramotor is a simple, rugged electro-hydraulic valve operator powered from two-wire electrical circuits for positive shut-off at all pressures, for indoor or outdoor applications, unaffected by hot or cold temperatures. Motor-equipped valves are available or motor operators for any type of valve may be furnished. Write to General Controls Corp., 801 Allen Ave., Glendale, Calif. for complete Hydramotor Catalog or check the reply card.

Zeolite Water Softeners End Hard Water Troubles

587. A 20-page catalog on Permutit water softeners has been released by The Permutit Co., 50 West 44th St., New York 36, N. Y. Schematic diagrams, chemical reactions, operation of the water softener and specifications are some of the sections covered. Check the reply card today.

Air Control Valves For All Types of Pipelines

620. Literature on Crispin Air Valves, which safely control air in lines handling liquids, to maintain efficient operation and prevent expensive failures, is available from Multiplex Manufacturing Company, Dept. C, Berwick, Pa. Write today for your copy of the Crispin Air Valve Catalog, which offers complete information on the full line of dependable Crispin Air Valves.

Paints For Bridges, Water Tanks & Other Metal Structures

624. Flake silica graphite paints for outdoor metals are described fully in literature from Paint Sales Div., Joseph Dixon Crucible Co., Jersey City 3, N. J. Check the reply card for details on these primer and protective paints.

Combination Pipe-Leak Locator

744. Information on an electronic multipurpose instrument that solves both pipe location and water leak detection problems is available from The Goldak Co., 1544 W. Glenoaks Blvd., Glendale 1, Calif. Check the reply card today.

Transite Pressure Pipe For Water Systems

775. Transite pressure pipe and the Ring-Tite coupling are described in Bulletin TR-160A from Johns-Manville, 22 East 40th St., New York 16, N. Y. Check the reply card for full details on this water pipe.

Tyton Joint For Water

779. McWane Tyton joint and mechanical joint cast iron pipe are described in catalog from McWane Cast Iron Pipe Co., Birmingham 2, Ala. Check the reply card for details on pipe from 2 through 12 ins.

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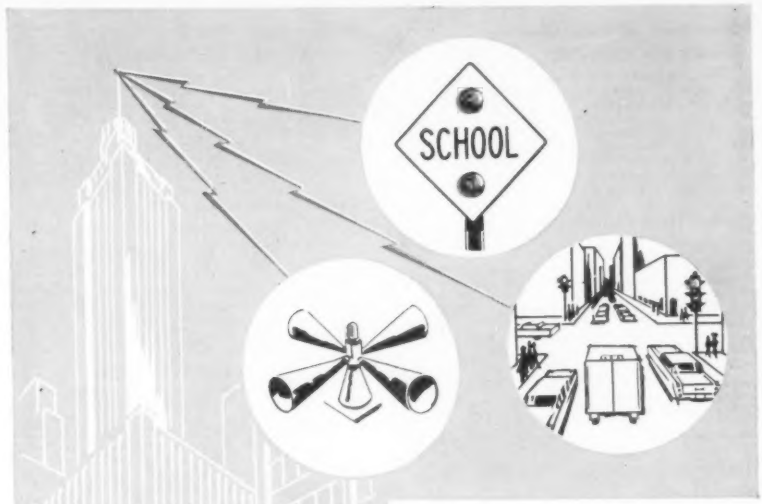
SEWERAGE AND WASTE TREATMENT

What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay underdrain blocks conforming to ASTM standards, suggestions for layouts and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute c/o Editor, Public Works, 200 So. Broad St., Ridgewood, N.J. Check the reply card and we will forward your request.

How to Make Better Sewer Pipe Joints

37. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston Co., Dept. P.W., Adams, Mass. Check the reply card.



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To order these helpful booklets check the reply card opposite page 54.

A Handbook of Sewer Cleaning Methods and Materials

44. Complete easy-to-follow directions for every type of sewer cleaning operations and the equipment needed for effective cleaning work is covered in a 48-page booklet issued by Flexible Inc., 3786 Durango, Los Angeles 34, Calif. Full details are provided on power cleaning machines, the SeweRodeR, hand tools and all accessories. Water main and culvert cleaning methods are included.

Helpful Design Data For Sewage Ejectors

81. The application and advantages of pneumatic sewage ejectors are outlined in bulletin S-55 of the Blackburn Smith Mfg. Co., Inc., Hoboken, N. J. Included are piping diagrams for electrode and float switch controls plus dimensions and layouts for single and duplex systems.

Use The Reply Card

Theory of Controlled Digestion With Floating Cover Tanks

88. In an excellent 40-page booklet, an authoritative discussion of digestion theory and practices, including design, operation and economics is presented by the Pacific Flush Tank Co., Chicago 13, Ill. Complete data are given on the use of floating covers, together with details on tank construction, piping and control chambers.

Catalog on the Flynn and Emrich Incinerator Stokers

180. This catalog describes the Flynn and Emrich Incinerator stokers as to design, feeding capacities and loadings. Plenty of drawings of the stokers and photographs of incinerator plants under construction and in operation are included. Also, there is a good section on the incinerator history. Check reply card for catalog No. 1702 from Flynn and Emrich Co., Holiday and Saratoga Sts., Baltimore 2, Md.

Reduce Labor Costs With Power Sewer Cleaners

189. A complete line of sewer cleaning equipment, including labor saving power units and all types of buckets, cables, rods and flushing equipment are listed in catalog of the Turbine Sewer Machine Co., Division of Chas. H. Stehling Co., 1303 N. Fourth St., Milwaukee 12, Wis. Check the reply card for your copy.

Get Data Now on This Catch Basin Cleaner

198. Simple powerful pneumatic bucket is featured by Netco Catch Basin Cleaner. Folder 33A gives details and illustrates operation of complete self powered truck mounted unit, Netco Div., Clarke Wilcox Co., 118 Western Ave., Boston 34, Mass. Check the reply card.

How to Dispose of Sewage and Industrial Sludges

281. Get full information on the C. E. Raymond System of combined incineration and sludge drying providing high temperature deodorizing for nuisance-free sludge disposal. Flexible layouts fit large and small communities. Use handy reply card or write Combustion Engineering Inc., Raymond Div., 1315 No. Branch St., Chicago, Illinois.

Modern Methods and Materials For Jointing Sewer Pipe

402. In a compilation of reprints and related supplementary material, the Atlas Mineral Products Co., Mertztown, Pa., presents a comprehensive review of all types of sewer jointing materials and methods. You will find this interesting and informative reading.

Diaphragm & Plunger Type Dual Valve Sludge Pumps

411. A 4-page bulletin on diaphragm and plunger type dual valve sludge pumps is available from Komline-Sanderson Engineering Corp., Peapack, N J. Sludge pump is designed for feeding sewage to vacuum filter and the diaphragm pump is intended for pumping heavy slurries. Check the reply card for complete descriptions and selection charts.

Vitrified Clay Floor System For Trickling Filters

452. The IMCO two unit floor is noted for its mechanical strength, simplicity of construction and large percentage openings for aeration. The units are self spacing and easily set in place. Check the reply card or write Industrial Materials Co., Somerset St. and Trenton Ave., Philadelphia 34, Pa., for complete catalog.

Complete Treatment Unit for Handling Flows to 0.5 MGD

503. Developed for sewage flow characteristics of small communities, the Aerator-Clarifier is a complete treatment unit utilizing automatic balance of activated sludge solids with sewage flow. Bulletin 129, issued by the Chicago Pump Co., 622 Diversey Parkway, Chicago 14, Ill., describes application of this unit. Check the reply card.

Underground Pumping Stations, Complete Package Units

522. Pre-fabricated automatic underground pumping stations that are completely assembled for quick, economical installation are described fully in literature available from Schmieg Industries, Inc., Pumping Station Div., 23930 Sherwood, Center Line, Mich. Generous access space between pumps and accessible sump pump location are a few features.

Application and Design of Prefabricated Pumping Stations

637. This manual is intended for a guide in designing sewage pumping stations and in explaining the use of prefabricated underground sewage pumping stations. Check the reply card or write to Zimmer & Francescon, 1715 Fifteenth Street Place, Moline, Ill., for your copy.

Spiragester, A Combination Clarifier and Digester

709. A 22-page catalog is available from Lakeside Engineering Corp., 222 W. Adams, Chicago, Ill. describing the Spiragester. Check the reply card for operation of, the unit, advantages, specifications, samplers and painting.

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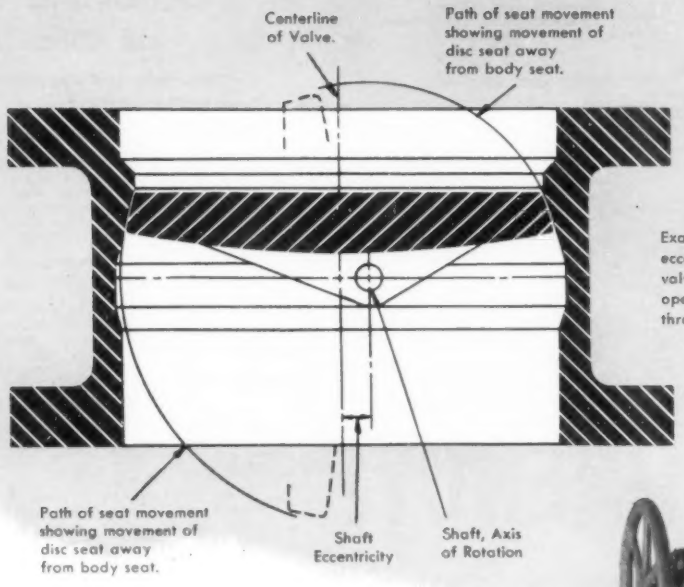
Centerline of Valve.
Path of seat movement showing movement of disc seat away from body seat.
Path of seat movement showing movement of disc seat away from body seat.
Shaft Eccentricity
Shaft, Axis of Rotation

Exaggerated diagram showing eccentricity of valve shaft in relation to valve axis and how the disc, upon opening, is lifted from the body seat throughout its entire circumference

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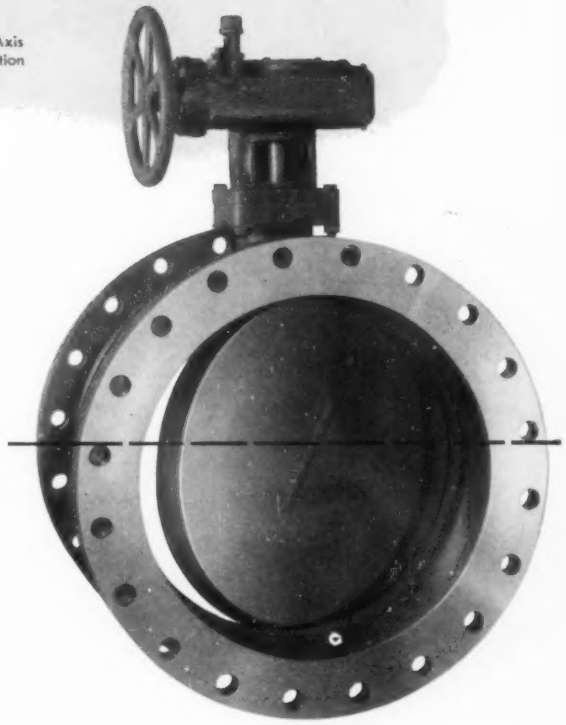

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Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford, Ont.

DARLING VALVES

To order these helpful booklets check the reply card opposite page 54.

Engineering Data Manual on Underground Lift Stations

218. This 100 page manual includes descriptive bulletins, specifications covering typical installations for pump type or ejector type stations, friction loss tables covering capacities and size of pipe, pump and motor selection charts and wiring diagrams. Check the reply card or write Smith & Loveless, Inc., Water and Sewage Equipment, P. O. Box 8884, Kansas City, Mo.

Grit Collecting And Grit Washing Equipment

580. This 28-page book on grit collecting and grit washing equipment is profusely illustrated and contains data on 7 types of grit collectors, 2 grit washers and the Tritor screen. Detailed drawings and specifications are included to assist the engineer in the preparation of drawings. For your copy of Book 2571 check the reply card or write the Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill., today.

Press-Seal Rubber Gaskets to Seal Joints of Concrete Pipe Sewers

623. Rubber gaskets for sealing the joints of concrete sewer pipe are described fully in literature available from Press-Seal Corp., P. O. Box 482, Fort Wayne, Ind. Check the reply card for information on how these gaskets prevent water infiltration in sewer lines.

Pneumatic Ejectors—Their Operation and How to Select the One You Need

500. Comprehensive data on pneumatic ejectors is furnished in a 28-page catalog issued by the Ralph B. Carter Co., 210 Atlantic Street, Hackensack, N. J. The principle of operation, construction features, operating arrangements, and controls are discussed fully. Selection charts with illustrative examples help in specifying the proper ejectors, air tanks and compressors. Complete layout dimensions and sample specifications are included. To get this valuable reference, Bulletin 5408, just check the handy reply card.

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Standard Steel Works, Inc. NORTH KANSAS CITY, MO. PO-157

CONSTRUCTION EQUIPMENT AND MATERIALS

Do You Have An Independent Source of Electricity?

27. An independent source of electricity which will supply power for vital services when regular sources fail can be invaluable during emergencies. Check Kohler Bulletin KEP 56-1 which furnishes data that will help you select the plant best suited for your needs. Many models, 500 watt to 50 Kw, portable and stationary are described. Write the Kohler Co., Kohler, Wis., or use the reply card.

Tractor Loader Can Be Converted Into Eight Different Machines

38. Multiple-purpose tractor loader can be converted to a street sweeper, backhoe, fork lift, angle dozer, crane and rotary broom in a short time. Check the reply card or write Massey-Ferguson Industrial Div., 1009 South West St., Wichita 13N, Kans., for well illustrated catalog.

For Fast, Smooth Pipe Cuts

68. Descriptive literature on the Reed 4-wheel hinged pipe cutter which operates in close quarters, gives quick, easy right-angle cuts, and is available from Reed Mfg. Co., Erie, Pa. Check the reply card.

Sidecrane-Backfiller-Tamper, A Versatile 3-Way Machine

125. A 3-way machine, the Cleveland 80W, that is a backfiller, sidecrane and tamper is described fully in a 12-page Bulletin, No. L-102, available from The Cleveland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio. Design and construction features, photographs of the machine in operation and complete dimensions and specifications are covered. Check the reply card.

Heavy Duty Air Cooled Engines For Many Uses

223. Power and weight specifications, dimensions and uses are fully covered in literature issued by Wisconsin Motors Corp., Milwaukee 46, Wis., on their air-cooled engines. Also available is a service map and a list of their distributors and approved service stations.

Manual on Coatings to Stop Rust

235. Primer type, short oil type, heat resistant, chemical resistant and floor coatings are a few of the items covered. Also complete data on Rust-Oleum products are included. Check the reply card or write Rust-Oleum Corp., Evanston, Ill., for this valuable manual.

Booklet Shows Design of Pre-Engineered Steel Buildings

271. Pre-engineered Butler steel buildings are available in every size, type and design to meet your buildings needs. In a helpful 16-page booklet you will find details on several basic designs and an unlimited variety of door, window and interior treatments; answers to your questions on construction and erection; and many illustrations of typical uses. Write to Butler Mfg. Co., Kansas City, Mo.

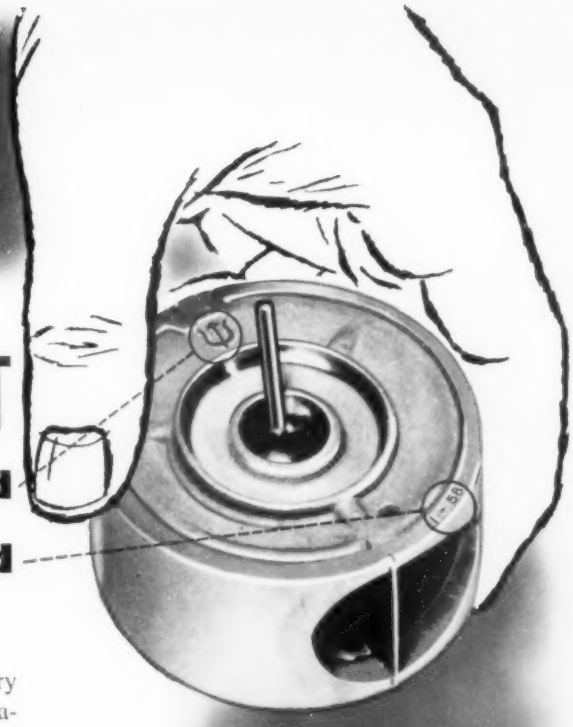
Tractor-Shovels With Drott "Four-In-One" Attachment

352. Hough rubber-tired front-end loaders come equipped with the Drott "4-in-1" bucket. Check the reply card or write The Frank G. Hough Co., Libertyville, Ill., for literature on how to use this unit as a shovel, clamshell, scraper and bulldozer.

Helpful Data on Distributors for Bituminous Materials

611. Pressure distributors featuring uniform pressure and temperature, accurate displacement pumping, convenient operation are described in literature of Standard Steel Works, North Kansas City, Mo.

Every TRIDENT Unit Identified and Dated



Trident water meters are precision instruments . . . every part made to extremely close tolerances . . . every material carefully selected and tested to give longest life in *your* water system.

Most important, every improvement made in new Trident meters immediately becomes available in repair parts for your older meters. You re-order only the latest parts. As you replace worn, out-dated parts over the years, your Tridents are *automatically* modernized.

for your protection

To protect you from substitutes . . . and to make sure you're getting the benefits of Neptune progress . . . the Trident trademark is put on most all Trident parts . . . and the *date* is put on every major Trident part. Take a look at these date marks. They show you how well Tridents last. They also show you how your older meters have been kept up to date over the years with improved Trident repair parts.

Insist on genuine Trident parts . . . and check to be certain.

NEPTUNE METER COMPANY
19 West 50th Street • New York 20, N. Y.

NEPTUNE METERS, LTD.
1430 Lakeshore Rd. • Toronto 14, Ont.

Branch Offices in Principal American and Canadian Cities.

neptune
TRIDENT WATER METERS

263

To order these helpful booklets check the reply card opposite page 54.

Restoration and Protection Of Concrete Structures

385. A "How to Do It" bulletin describing the Thoro System for repair and sealing interior and exterior masonry surfaces is available from Standard Dry Wall Products, Inc., New Eagle, Pa. The treatment for every water problem is presented in illustrated case histories in this useful publication.

International 6-Cylinder Carbureted Power Units

398. A graphically-illustrated 12-page catalog CR-511-G, on IHC 6 new 6-cylinder power units is available. Power and fuel consumption curves and cutaway views of component parts of the units are covered. Check the reply card or write Construction Equipment Div., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., for specifications.

The Trucks You Need for Every Public Works Job

461. Extra life and operating economies are built-in features of every Ford truck model. There's a chassis size and engine for each of your needs, from light utility work to heavy-duty construction jobs. Get latest literature from Ford Motor Co., Truck Div., Dearborn, Mich., by checking the reply card.

Complete Bulletin On Municipal Supplies

473. Everything from leak locators to street signs is listed in the big 108-page bulletin "Municipal Supplies" published by Darley. Hundreds of different items for all city departments are included. Get your copy of Bulletin No. 155 from W. S. Darley & Co., 2814 Washington Blvd., Chicago 12, Ill., by checking the reply card.

low initial cost
low erection cost
lowest maintenance cost

Here's a new all-aluminum sign developed especially for the large signs required on major expressways. The "Increment Sheet Sign" consists of aluminum increment sheets hung vertically on a supporting frame. It can be made in any height or width, and for ground or overhead installation. Each sheet engages with the adjacent sheet, providing a smooth-faced sign panel.

The advantages are obvious; new lows in the cost of material, installation and maintenance. The aluminum never needs painting or other costly maintenance. Erection is quick and easy. Reflective materials or painted backgrounds are available in any type letters or symbols. As for strength, the sign above, on New Jersey's Garden State Parkway, is designed to withstand wind in excess of 100 m.p.h.

Send today for new pamphlet with full engineering data.

ONE RESPONSIBILITY TOO

Through our associate company, Pfaff & Kendall, Tassco can offer a complete range of standards and supports for ground signs and overhead spans to meet any requirement.

TASSCO

TRAFFIC & STREET SIGN COMPANY
84 Foundry Street, Newark 5, N. J.

How to Get Better Grader Operation

111. A most interesting and instructive 20-page illustrated action booklet on how to operate a motor grader is now available from Galion Iron Works & Mfg. Co., Galion, Ohio. Designed to help operators get more effective use from the versatile motor grader, this booklet covers the hydraulic system, steering, tips on leaning wheels, proper blade positioning, turning, gear speeds and operating procedures. Colorful, easy-to-read presentation guarantees good readership. Check the reply card for your copy.

All Types of Accessories For Trucks

481. A 12-page two-color "Necessories" catalog describing and illustrating tested and approved accessories for IHC trucks is available from Consumer Relations Dept., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill. They include items for greater comfort, economy, safety and convenience in truck operation. Check the reply card.

Complete Line of Road Rollers and Compaction Equipment

520. Buffalo-Springfield's complete line of road rollers and compaction equipment is described in a 12-page illustrated Buletin No. S-73-157 just released by Buffalo-Springfield Roller Co., Division of Koehring Co., Springfield, Ohio. Check the reply card for on-the-job pictures, as well as construction details of the 2-axle tandems, 3-axle tandem, 3-wheel rollers and the K-45 Kompactor.

Principles of "BatchOmatic" Plants Explained

527. The unique principles of simultaneous and fully automatic aggregate and bitumen measuring followed on Barber-Greene's 2,000, 4,000 and 6,000 lb. "BatchOmatic" bituminous batch plants are explained with cut away drawings, charts and other illustrations in a 3-color bulletin offered by Barber-Greene Co., Aurora, Ill. Check the reply card.

Rigid Frame and Bow String Truss Steel Buildings

574. Featured in a 19-page colorful catalog are Stran-Steel's new series of steel buildings varying in widths from 32 to 80 ft. or multiples of those widths. Also described is the Stran-Satin metal wall and accessories for the buildings. Check the reply card or write Stran-Steel Corp., Detroit 29, Mich.

A Completely Hydraulic Ladder

610. This completely hydraulic ladder is described in a new catalog published by J. H. Holan Corp., 4100 West 150th St., Cleveland 11, Ohio. Detailed drawing of the pedestals, throttle control and ladder construction are included.

Most Complete Line of Portable Rotary Compressors

698. The Ingersoll-Rand Gyro-Flo is available in 6 sizes—85, 125, 210, 315, 600 and 900 cfm. Write Ingersoll-Rand, 11 Broadway, New York 4, N. Y., or check the reply card for information on these advanced-design rotary compressors.

Simplify and Save on Public Works Electrical Construction

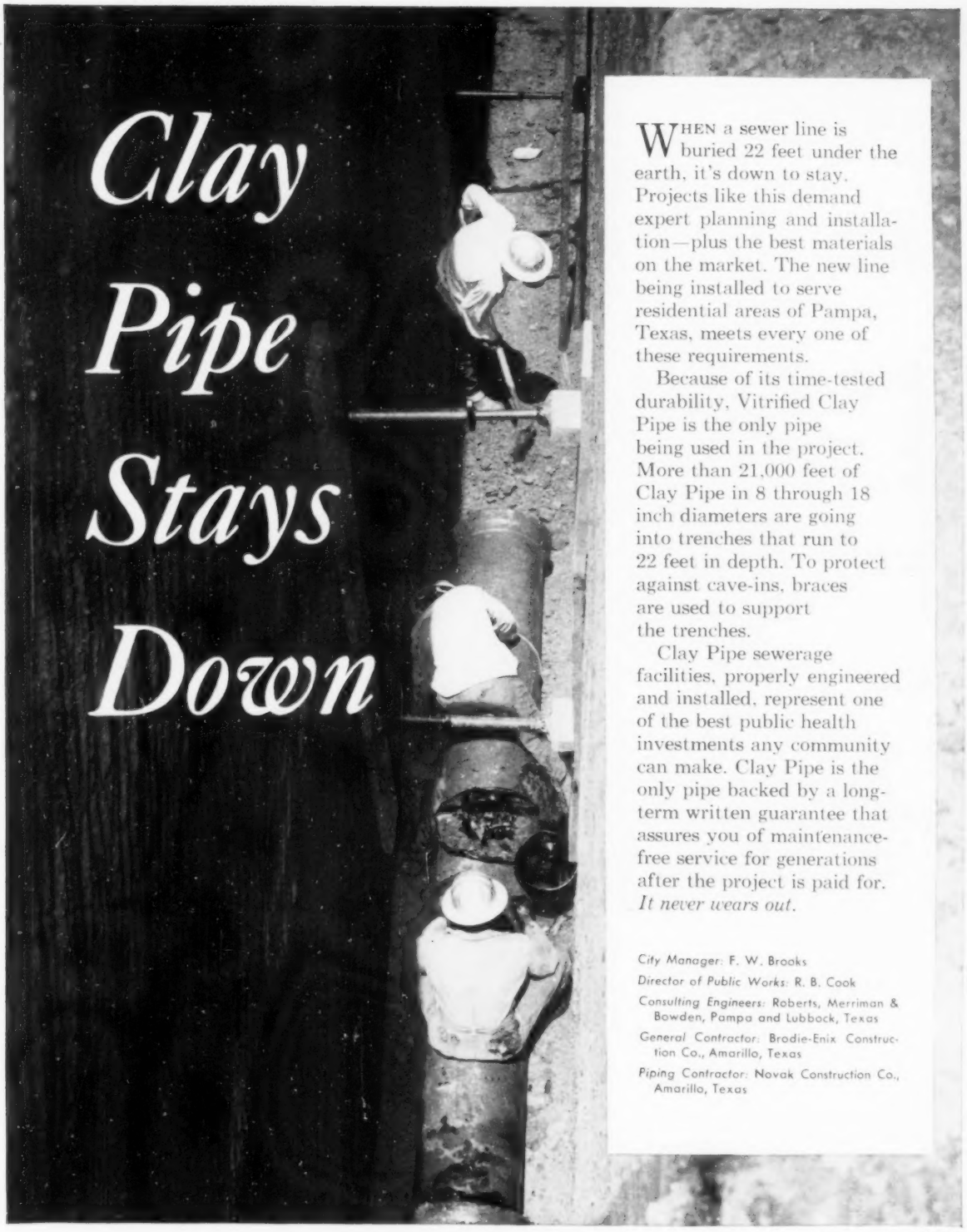
710. Information and literature is available from Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa., on how you can simplify electrical details of a public works project. Westinghouse field specialists will help you plan the electrical system to fit your need. Check the reply card.

Overhead Jobs, Painting, Tree Trimming Done By Strato-Tower

720. The Strato-Tower comes in 4 sizes, 35', 45', 65', 95' and has a 280° rotation. For complete details and prices write Strato-Tower Division, Elkhart Welding and Boiler Works, Inc., Elkhart, Ind., or check the reply card.

1958 Chevrolet Trucks Covered in Valuable Catalog

753. High-capacity panels, pick-ups, four-wheel drive models, dump and stake models are covered. Check the reply card or write Chevrolet Division of General Motors, Detroit 2, Mich., for information on these 6 cylinder and high-compression V8 trucks.



Clay Pipe Stays Down

WHEN a sewer line is buried 22 feet under the earth, it's down to stay. Projects like this demand expert planning and installation—plus the best materials on the market. The new line being installed to serve residential areas of Pampa, Texas, meets every one of these requirements.

Because of its time-tested durability, Vitrified Clay Pipe is the only pipe being used in the project. More than 21,000 feet of Clay Pipe in 8 through 18 inch diameters are going into trenches that run to 22 feet in depth. To protect against cave-ins, braces are used to support the trenches.

Clay Pipe sewerage facilities, properly engineered and installed, represent one of the best public health investments any community can make. Clay Pipe is the only pipe backed by a long-term written guarantee that assures you of maintenance-free service for generations after the project is paid for. *It never wears out.*

City Manager: F. W. Brooks

Director of Public Works: R. B. Cook

Consulting Engineers: Roberts, Merriman & Bowden, Pampa and Lubbock, Texas

General Contractor: Brodie-Enix Construction Co., Amarillo, Texas

Piping Contractor: Novak Construction Co., Amarillo, Texas

C-258-1

Vitrified **CLAY PIPE** *Never Wears Out*

NATIONAL CLAY PIPE MANUFACTURERS, INC. 1820 N Street, N. W., Washington 6, D. C.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio • 703 Ninth & Hill Bldg., Los Angeles 15, California • Box 172, Barrington, Illinois • 206 Mark Bldg., Atlanta 3, Georgia

To order these helpful booklets check the reply card opposite page 54.

STREETS AND HIGHWAYS

Calcium Chloride For Road Construction and Maintenance

41. Calcium chloride for concrete road construction, for maintenance of unpaved roads and for the control of ice are covered in literature from The Dow Chemical Co., Dept. CC503A, Midland, Mich. Check the reply card.

Hydraulic Highway Mowers For All Makes of Tractors

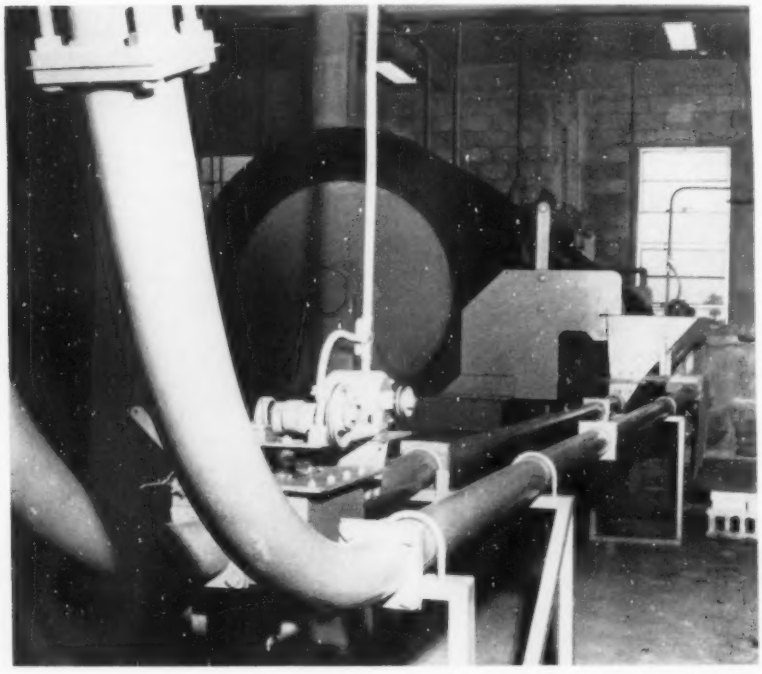
259. Mowers for roadside maintenance that are available for right, left or both side installation are described in catalog from A. C. Anderson, Inc., Wildwood, N. J. Specifications and models are fully covered. Check the reply card.

How to Select Prestressed Concrete Bridge Members

26. Colorful folder, well illustrated, shows manufacture of "Amdek" prestressed bridge members and provides selection tables covering several AASHO loadings. Full data from Concrete Products Div., American Marietta Co., 104 East Ontario St., Chicago 11, Ill. Check the reply card for your copy of this helpful reference bulletin.

How to Prepare and Maintain Roadways With Calcium Chloride

65. "The Calcium Chloride Road," is the name of a new 24-page two-color catalog issued by the Columbia-Southern Chemical Corp., 632 Fort Duquesne Blvd., Pittsburgh 22, Pa. Included are sections on dust control, gradation, placing and mixing materials and shaping. General information on spring, summer and fall maintenance is also provided. Check the handy reply card.



CONVEYOR SCIENCE at work at Coral Gables

Picture above is complete ground floor installation in Coral Gables, Florida, sewage treatment plant of Hapman hopper and conveyor. Komline-Sanderson Colifilter in background.

We invite you to try your design ideas with the versatile HAPMAN CONVEYOR for sewage, grit, vacuum filter cake, lime and alum.

Write for free catalog and list of municipal installations.

STUART CORP. **516 N. Charles Street Baltimore 1, Maryland**

Self-Propelled Sidewalk Paver Lays Up to 10 Ft. per minute

117. Bulletin 57, released by Dotmar Industries, Inc., Kalamazoo, Mich., describes the Dotmar paver, which can lay up to 10 ft. per minute of walk when working with transit mix units. Paver is readily convertible to pave curb and gutter, or integral curb, gutter and walk. Get the 8-page illustrated bulletin for full data and reports from users. Just check the handy reply card.

Illustrated Specifications on Brush and Limb Disposal

222. A new booklet on the modern approach to the brush problem shows how an Asplundh chipper reduces bulky branches and brush trimmings to chip size for mulch or easy removal. Write Asplundh Chipper Company, 505 York Road, Jenkintown, Pa., or use the handy reply card.

The Dilemma of Our Present Highway System

314. "Where Do We Go From Here?" is the title of a 16-page booklet produced by Caterpillar Tractor Company, Peoria, Illinois. Many highway problems are discussed in the interesting and informative booklet. Inadequate and obsolete highways, financing of free roads and toll roads, and whether to construct free roads or toll roads are a few of the topics. A section is devoted entirely to the story of modern highways from the planning stages through the construction stages to the finished roadways. Check the reply card for this booklet. Form 31398.

Manual on Steel and Wire for Road Building

337. Design data on wire fabric for concrete pavements, joint data, guardrail design standards, steel and wire for concrete pipe and reinforced bituminous concrete design are some of the sections covered. Check the reply card or write American Steel & Wire Div. of United States Steel Corp., Cleveland 13, Ohio, for this valuable manual.

New Acker Vane Shear Tester

367. A bulletin describing a new inexpensive accurate technique for obtaining "in-place" shear readings of soils is available from Acker Drill Co., Inc., Scranton 3, Pa. The shear test kit has a complete set of vane test tools for testing soils to depths of 100 ft., and operating information on this kit is covered in Bulletin 700, available by checking the reply card.

Plastic Filament Street Sweeper Pick-Up Brooms

436. Literature is available from Rynal Corp., 114 St. Joseph St., Arcadia, Calif., on plastic filaments for street sweeper pick-up brooms. They are easy to replace, storage space is eliminated and moisture will not attack them. Check the reply card.

Complete Line of Earth Boring Machines

591. A 16-page illustrated catalog on the Hydrauger line of boring machines has been released. Field operation photos and views showing embankment drainage and pipe line installation are included in this material available from Hydrauger Corp., Ltd., 681 Market St., San Francisco, Calif.

Construction Methods for Salt Stabilized Roads

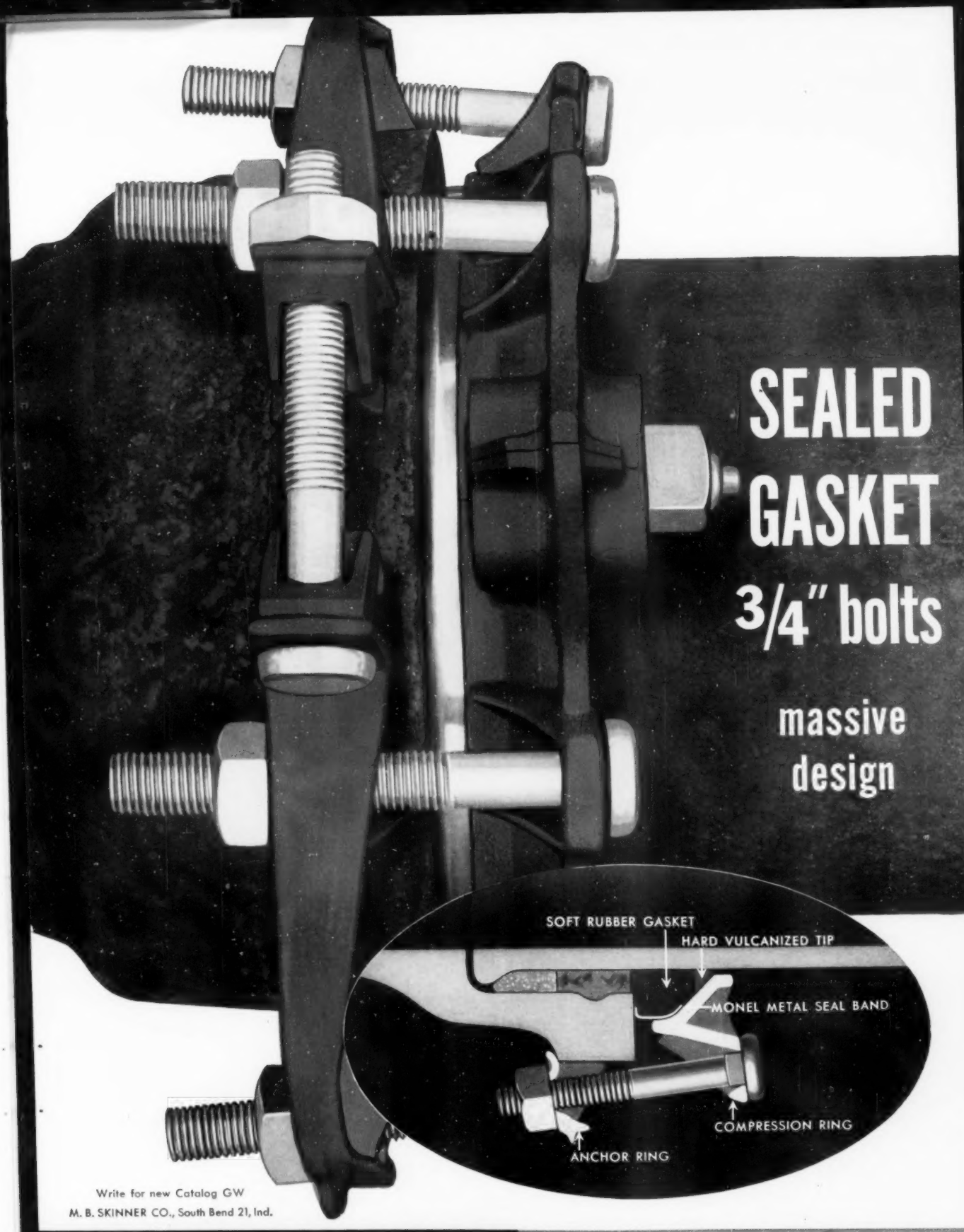
609. A comprehensive booklet showing modern methods of salt stabilization is available from the Morton Salt Co., 120 So. LaSalle St., Chicago 3, Ill. Stabilized secondary roads, base courses and shoulders are discussed and all equipment and construction methods are covered. Just check the reply card for your copy.

Slide Rule PS1 Calculator For Concrete

713. A new pocket size slide rule calculator for the testing of concrete in compression is available from Forney's Inc., P.O. Box 310, New Castle, Pa. It is designed to convert instantly the pressure applied to concrete cylinders and blocks into psi.

Overlaid Plywood For Highway Signs

764. Highway signs that are made of overlaid plywood that will not bend, crack or rust are described in literature from Simpson Logging Co., 2301 N. Columbia Blvd., Portland 17, Oregon. Check the reply card for data on both medium and high density plywoods.



Write for new Catalog GW
M. B. SKINNER CO., South Bend 21, Ind.

SKINNER-SEAL BELL JOINT CLAMP

To order these helpful booklets check the reply card opposite page 54.

Self-Propelled Ditching Machines

438. Information on a self-propelled one man operated ditching machine, model 524 T, model W-2 and a new midget ditcher, model 4 T, for light construction is now available from the Vermeer Mfg. Co., Pella, Iowa. The Model 524 T digs 8 to 24 inches wide and down to 6 feet deep, while the model 4 T digs 6 to 14 inches wide and down to 4½ feet deep. Model W-2 Ditcher digs from 2" wide up to 4" down to a depth of 30". Full data on these ditchers available by checking the reply card.

Ultra-Clean Sweeping For Streets, Yards and Airports

499. A new approach to extra-clean sweeping is described in a 4-page illustrated Bulletin (No. 85.55) issued by the G. H. Tennant Co., 755 N. Lilac Drive, Minneapolis 22, Minn. Described is a 7'4" path sweeper that eliminates the use of water for dust control. Check the reply card.

Bitumuls Paving Handbook Full of Useful Data

23. The latest edition of the Bitumuls Paving Handbook covers a wealth of practical data on paving methods and materials, road and airport paving specifications and construction details, complete tabular data on asphaltic binder applications and aggregate requirements, condensed Asphalt Institute specifications plus data on Laykold compounded asphalts for flooring, tennis courts, protective coatings and waterproofing. You can have a copy by checking the reply card. American Bitumuls & Asphalt Co., 320 Market St., San Francisco 20, Calif.

Literature on Reflective Glass Beads

570. Glass beads for traffic signs and street name signs are described in literature available from Flex-O-Lite Mfg. Corp., 8305 Flex-O-Lite Drive, P. O. Box 3066 (Affton Br.), St. Louis 23, Mo. Beads can be used on white and yellow signs. Check the reply card.

Diamond Blades For Sawing Concrete

766. Felker Di-Lock diamond blades for cutting concrete pavements are described in literature available from Felker Mfg. Co., Torrance, Calif. Check the reply card.

Catalog on All Phases of Brush Disposal

771. This informative 2-color catalog gives complete detailed information on Fitchburg Chippers, and includes drawings, specifications, diagrams and charts. Check the reply card or write Fitchburg Engineering Corp., Fitchburg, Mass., today.

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STREET LIGHTING AND TRAFFIC CONTROL

Engineering Guide to Mercury Street Lighting

380. Basic engineering aspects of mercury vapor street lighting are discussed in a 35-page Engineering Guide available from Westinghouse Corp., Box 2099, Pittsburgh 30, Pa. This practical reference includes technical data on mercury lamps applicable to general lighting service, operating characteristics of the system and a discussion of methods of economic evaluation of alternative lighting systems.

A Guide to Effective Traffic Safety

468. A 20-page catalog with hundreds of illustrations of all types of signs used on highways and in motor and pedestrian traffic areas is offered to public works officials by Traffic and Street Sign Co., 84 Foundry St., Newark 5, N.J. This convenient reference covers all your sign needs.

Practical Outdoor Lighting

489. P & K luminaires and standards for outdoor lighting provide good lighting and complement the architecture and design. Check the reply card or write Pfaff & Kendall, 84 Foundry St., Newark 5, N. J., for models and types.

Monotube Overhead Sign Supports For Highway Marking

567. Monotube overhead sign supports for freeways, turnpikes, expressways and general highway use are described fully in catalog available from the Union Metal Mfg. Co., Canton 5, Ohio. The catalog describes in detail both double and single post designs, including assembly and installation details, dimensional data and some of the possible variations. Plenty of photographs and drawings are included. Check the reply card for your copy today.

•

WEED AND DUST CONTROL

Investigate "Tifa" For Insect Control

47. With "Tifa", the Todd Insecticidal Fog Applicator, chemicals are distributed as a true, clean fog. Use reply card for full data on public health programs. Products Div., Todd Shipyards Corp., Columbia & Halleck Sts., Brooklyn 31, N. Y., Greens Bayou, Houston 15, Texas.

How to Cut Weed Control Costs

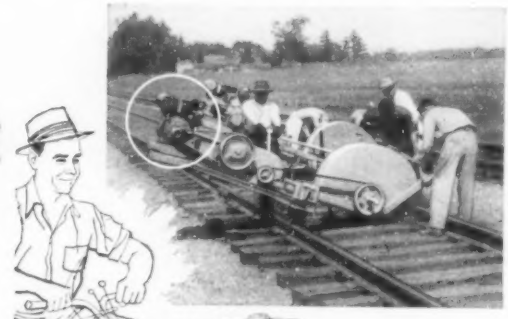
308. Information on a weed killer that can save hundreds of man-hours of clearing and cutting is available from Diamond Alkali Co., 300 Union Commerce Bldg., Cleveland 14, Ohio. Whether you want to control weeds or brush or both, without damage to crops or ornamentals, get this literature today by checking the reply card.

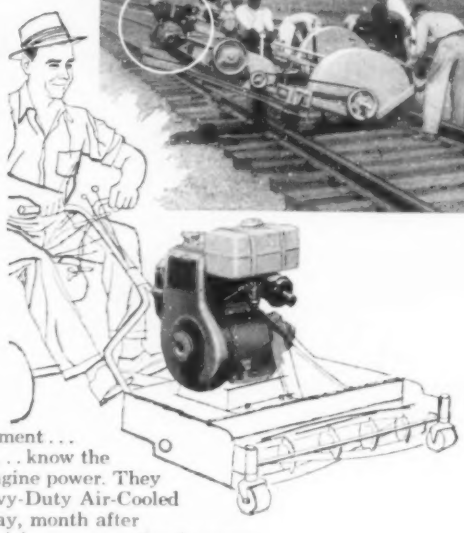
How to Stop Bothersome Dust

433. A bulletin that covers the use of calcium chloride in the control of dust is available from Wyandotte Chemicals Corp., Michigan Alkali Div., Wyandotte, Mich. Tables on the use of calcium chloride psy are included. Check the reply card.

How Power Performance On Railway Maintenance-Of-Way Equipment

can help you select the right mower engine





Doesn't it make a lot of sense to take a tip from the men who supervise men and machines? Supervisors of maintenance-of-way equipment . . . professional railroad men . . . know the importance of unfailing engine power. They know that Wisconsin Heavy-Duty Air-Cooled Engines work day after day, month after month with minimum servicing . . . operating in many cases many miles from the facilities of a service shop. Wisconsin Engines are *first choice* in the railway maintenance field.

While you may never give your mower engine the rough, punishing treatment a Wisconsin gets on railway maintenance assignments, it's good to know your Wisconsin is built to take it season after season, delivering the most heavy-duty service with a minimum of servicing. Your men go to work and *stay* until the job is done. The manhours you pay for become *work hours* when your mower is Wisconsin-powered. Write for bulletin S-223, today, describing all Wisconsin Engines.

2,000 service stations . . . several near you!

WISCONSIN ENGINE POWER

first choice of professionals.

MOST H.P. HOURS

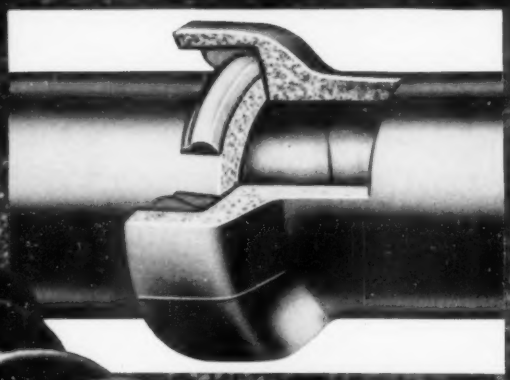
WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

NEW **Wedge-Lock*** JOINTS

Greatest Contribution to Sanitary Engineering since Vitrified Clay Pipe



LIKE A RAILROAD COUPLING... WEDGE-LOCK JOINTS WEDGE IN! LOCK TIGHT! IN ONE SIMPLE, EASY OPERATION

When you want to set high performance standards . . . control infiltration to strict specifications and reducing pumping costs . . . handle root problems . . . insure completion of the job exactly as originally designed . . . maintain lower cost-in-place due to faster, easier installation . . . you'll call for the *best* factory-made joint. Bonded-on Wedge-Lock Joints go in as fast as the trench is dug . . . "snap" tight instantly, in continuous compression . . . last as long as the world's longest lasting pipe.

Always specify *Vitrified Clay Pipe*, with *Wedge-Lock Factory-Made Joints*. Write to listed manufacturers for literature or an actual Wedge-Lock demonstration.

*Patented . . . T.M. Reg. U.S. Pat. Off.

Wedge-Lock CLAY PIPE

THE FACTORY-JOINTED CLAY PIPE AVAILABLE NATIONALLY FROM LOCAL MANUFACTURERS

Order Wedge-Lock from any of these Vitrified Clay Pipe Manufacturers:

Cannelton Sewer Pipe Company, Cannelton, Ind.
Clay City Pipe Company, Uhrichsville, Ohio
The Evans Pipe Company, Uhrichsville, O.
Gladding, McBean & Company, Los Angeles 54, Cal. *(Sold under trade name, "SPEED-SEAL")*
The Logan Clay Products Company, Logan, Ohio
Oconee Clay Products Company, Milledgeville, Ga.
Pacific Clay Products, Los Angeles 54, Calif.
Pine Hall Brick & Pipe Company, Winston-Salem, N.C.
Pomona Terra-Cotta Company, Greensboro, N.C.
The Robinson Clay Product Company, Akron 9, Ohio
The Stillwater Clay Products Company, Cleveland 16, Ohio

WLC-258-99

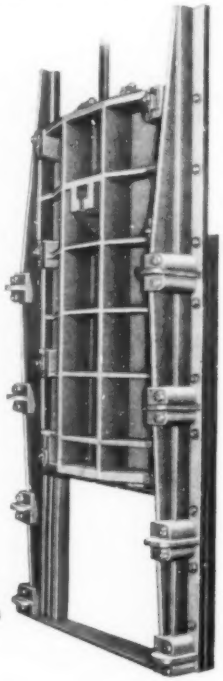
For complete drainage...

Rodney Hunt HY-Q Flush Bottom Closure Sluice Gates will permit complete emptying of a chamber or channel without pumps or other drain valves. Unlike any other design, the Rodney Hunt HY-Q gate seats on a sill flush with the invert. There is no raised sill wall, such as required with conventional gates, to prevent complete drainage. In addition to other operating economies, the HY-Q gate saves the cost of auxiliary pumping equipment and allows access to a fully drained chamber.

HY-Q® SLUICE GATE

The first basic sluice gate improvement in years features a resilient seal fastened at the bottom of the sliding disc to provide a cushioned closing at the stop bar. This flush bottom closure results in the construction economies of smaller gate sizes, narrower channels and lower channel walls for a given volume of flow . . . and provides unmatched design flexibility for water, sewage treatment and similar projects.

For full design and specification data, write for your copy of Catalog 75.



RODNEY HUNT®

RODNEY HUNT MACHINE CO.

Water Control Equipment Division
82 Water Street, Orange, Mass., U. S. A.

Serving water control engineers with equipment and engineering

REFUSE COLLECTION AND DISPOSAL

Increasing the Efficiency of Bulk Rubbish Collection

177. Strategically spotted bulk containers can be handled by one man operating a Dempster-Dumpster equipped truck. Get full details of this cost-saving system of rubbish collection, as used by many cities to increase efficiency and eliminate unsanitary conditions. Write Dempster Brothers, Inc., 952 Dempster Bldg., Knoxville 17, Tenn., or use the handy reply card.

Refuse and Garbage Packer Bodies

241. Ranging in capacity from 12 to 24 cu. yds., the M-B packers have a 30 second compaction cycle and have large side loading doors. Write M-B Corp., New Holstein, Wisc., or check the reply card for bulletin on specifications.

General Specifications for Refuse and Garbage Trailers

251. Two bulletins, one on the Pak-Mor 38 cu. yd. tandem axle trailer unit and the other on the Pak-Mor 32 cu. yd. trailer for use with Model GRD Dempster are available from Pak-Mor Manufacturing Co., Box 6147, San Antonio, Texas. General specifications, power train, operating procedures, maintenance and lubrication and other helpful information are included.

Planning A Sanitary Landfill

287. Covered in this manual is how to work various types of terrain efficiently for sanitary landfills. Swampy land, river bottom land, gravel pits, strip mines, and flat land operation are the sections. Write to Caterpillar Tractor Co., Peoria, Ill., or check the reply card for your copy.

What You Should Know About Refuse Incinerators

362. Two helpful bulletins tell what you should know about low cost refuse incineration for the small community and for larger cities. Your questions on mechanical stoking, burning rates and operating problems are discussed. Get Bulletins 217 and 223 from Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y. Just check the reply card.

Methods and Benefits of Sanitary Landfill

409. Information on Sanitary landfill methods, organization and necessary equipment with which to carry out the job is available from the Construction Machinery Div., Allis-Chalmers Mfg. Co., Milwaukee, Wis. Check the reply card today.

Data on Refuse Collection Bodies

615. The Hydro E-Z Pack compacting unit has only 2 working parts—a high volume roller bearing pump and a double-acting telescopic cylinder. A refuse-crushing compacting pressure of 82,500 lbs. is attained in the units. Write Hydro E-Z Pack Co., Galion, O., or check the reply card for complete specifications.

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System For Duplicating and Filing Engineering Drawings

754. The Recordak system for comprehensive filing of engineering drawings is described in literature available from Recordak Corp., 415 Madison Ave., New York 17, N.Y. Drawings are first microfilmed and then they are added to an aperture card for indexing.

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COLLECT KNOW-HOW IN A HURRY See pages 34 to 54 and 189 to 195 for a quick review of new products and valuable literature. To get the data you need, circle corresponding numbers on the tear-out card on this page, print your name, title and address, and drop in the mail.

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Purdue Industrial Waste Conference
Layafette, Ind., May 5-7

Pa. Society of Professional Engineers
Reading, Pa., May 8-10

Up-State N. Y. Chapter Conference, APWA
Rochester, N. Y., May 11-13

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Spokane, Wash., May 15-17

Arizona Section, AWWA
Arizona Section, FS&IWA
Tucson, Ariz., May 15-17

New York Section, FS&IWA
Liberty, N. Y., May 26-27

N. Y. State Ass'n. of Municipal Engineers
Lake Placid, N. Y., June 2-4

New England Section, FS&IWA
Gardner, Mass., June 4-5

Alabama Section, FS&IWA
Auburn, Ala., June 4-6

Material Handling Exposition
Cleveland, Ohio, June 9-12

National Society of Professional Engineers
St. Louis, Mo., June 11-14

Maryland-Delaware Section, FS&IWA
Frederick, Md., June 12-13

Western Area Spring Conference, APWA
San Diego, Calif., June 15-18

Ohio Section, FS&IWA
Toledo, Ohio, June 18-20

Iowa Section, FS&IWA
Council Bluffs, Iowa, June 18-20

American Society for Testing Materials
Boston, Mass., June 22-27

Michigan Section, FS&IWA
Charlevoix, Mich., June 23-25

Pennsylvania Section, AWWA
Erie, Pa., June 25-27

School for Highway Superintendents
Ithaca, N. Y., June 30-July 2

Pennsylvania Section, FS&IWA
University Park, Pa., August 13-15

Michigan Section, AWWA
Grand Rapids, Mich., Sept. 8-10

Public Works Congress & Equipment Show, APWA
Kansas City, Mo., Sept. 28-Oct. 1

National Institute of Governmental Purchasing, Inc.
Boston, Mass., Oct. 5-8

Federation of Sewage & Industrial Wastes Ass'n.
Detroit, Mich., Oct. 5-9

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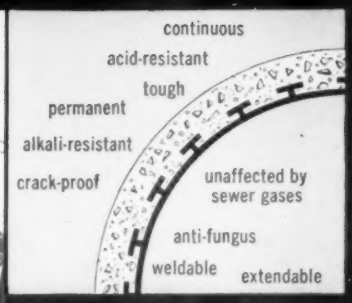

Tunnels present no difficulty even when using collapsible forms.

MILLIONS OF SQUARE FEET NOW IN USE! T-Lock Amer-Plate permanently ends corrosion in concrete sewer systems—because it is impervious to hydrogen sulfide, other sewer gases, fungus, bacteria, acids, alkalies and salts.

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Readily adaptable to complex forms for cast-in-place structures.

T-Lock in place on inner form before pipe is poured.

Transite Pressure Pipe is tested to AWWA specifications

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"An efficient water system ranks high among the many advantages Providence offers industry"

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Few community investments bring a greater year-in, year-out return than a modern water supply system. For it favorably affects every phase of community life—adding to comfort, convenience, fire-safety . . . contributing to an active, growing business climate . . . saving tax dollars for other uses.

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Let us send you booklet TR-160A. Write Johns-Manville PW Box 14, New York 16, N. Y.

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Attractive MONOTUBE LIGHTING POLES

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Steel or aluminum . . . round or fluted . . . davit or bracket type design . . . anchor or transformer base . . . Union Metal's half-century of lighting pole manufacturing experience is your guarantee of complete satisfaction.

Catalog information is readily available upon request. Write The Union Metal Manufacturing Company, Canton 5, Ohio. In Canada: The Union Metal Manufacturing Company of Canada Limited, Brampton, Ontario.

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Monotube Lighting Poles

This installation was an award-winning entry in the 1957 International Lighting Competition. It was designed by Palmer & Baker, Inc., Consulting Engineers, Mobile, Alabama.

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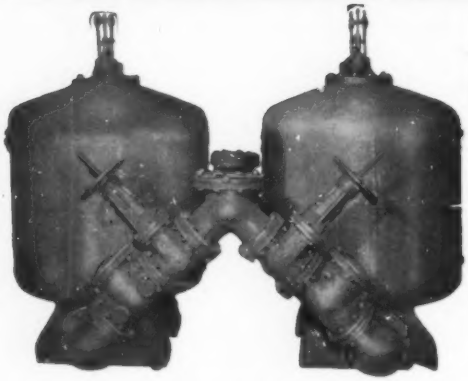

Duplex Ejector Twin Units for discharge rates of 30 to 500 g.p.m., heads up to 150 ft. Also made in single units.

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LETTERS TO THE EDITOR

RESOLUTION ON OPERATOR TRAINING

Your editorial in the February issue headed "Focusing National Attention on Water & Sewage Works Operating Training" is most timely, and we in the Iowa Association wish to second it most enthusiastically and to compliment you for pointing up the problem so strikingly.

I will enclose a copy of a resolution recently prepared by our group and distributed rather widely by the Federation. I am sure that the backing of your magazine will be of great help in bringing this program to life.

Harris F. Seidel
Superintendent
Water and Sewage Treatment
Ames, Iowa

ROMANCE IN WATER SUPPLY

It may be the popular idea or conception that "Romance" occurs only in love, religion, movies, sports and similar human activities. That is not so.

An important point for the consideration of young men and, perhaps, young women, in deciding on their life work, is that public water supply engineering is an interesting and romantic profession. This is my conclusion from my first forty-four years in such work.

For this period my water supply engineering experience has been in sixteen states and has covered over four hundred municipal and other water supply projects. This work has involved meeting and working with public officials on investigations, reports and designs; preparation of detailed construction plans; and specifications and supervision of construction. During World War I the writer was in the Army as a Camp Sanitary Engineer; during World War II he was civilian water supply engineer for a shell loading plant, and was engaged on other Army and Navy water supplies.

In 1913 the writer was one of six of the first graduating class in Sani-

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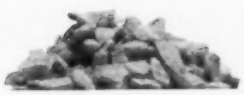

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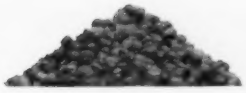

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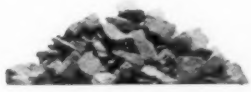

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NEW *CATIONIC* BITUMULS

- **Treats Most Aggregate... Especially "Treacherous" Types Such As Shown Here**
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CATIONIC Bitumuls,® our new, cold-applied asphalt emulsion, is a truly versatile binder with a "native" affinity for all aggregate, even damp, slick, "hard to coat" gravel and other hydrophilic stone. It also sets more rapidly than conventional road emulsions.

This combination of properties offers definite advantages to the Roadbuilder:

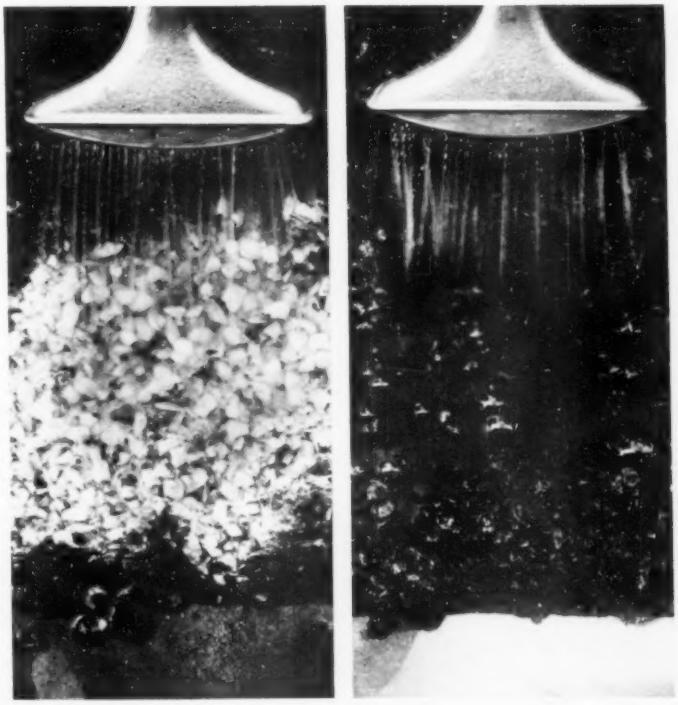
Wider selection in the use of local, often lower-cost, aggregates.

Extended working season . . . better protection against sudden showers.

Faster set permits early rolling of coarse aggregate mixes, and fast opening of pavement to traffic.

Storage, handling and application are much the same with **CATIONIC** Bitumuls as with conventional emulsions; however, care must be exercised in the preparation of storage facilities and application equipment.

CATIONIC Bitumuls is available from certain of our strategically located plants. Our engineers are ready to discuss projects which you may wish to set up for trials of this new product with specific types of aggregate.



Proof . . . the superior coating and holding properties of new **CATIONIC** Bitumuls are clearly demonstrated in this test. Note the almost-complete wash-out of the conventional road binder (left); while **CATIONIC** Bitumuls (right) firmly holds the crystal-silica chips used for these test mix samples.

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TRANSISTORIZED PIPE LOCATOR

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MODEL TR-1

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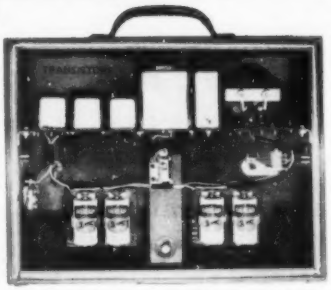
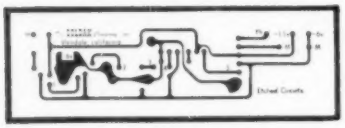


SPECIFICATIONS:

Operating Weight
Transmitter — 4½ lbs.
Receiver — 4¾ lbs.
Circuit
Transmitter — one transistor
Receiver — six transistors
Batteries
Transmitter — 4 size C flashlight cells
Receiver — 4 size C flashlight cells
Sensitivity — 18 ft. depth range, approximately 200 ft. average tracing distance.

Again, Goldak proves their leadership in the locating field with this Transistorized Pipe Locator. Featuring Transistors, Printed Circuit Boards and Packaged Circuits for better locating; small sized Flashlight Batteries for maintenance savings...Transistors and other components encapsulated preventing temperature, humidity, shock, vibration problems. Designed for pinpoint detection of underground pipes, cables, mains, laterals, valves, etc.



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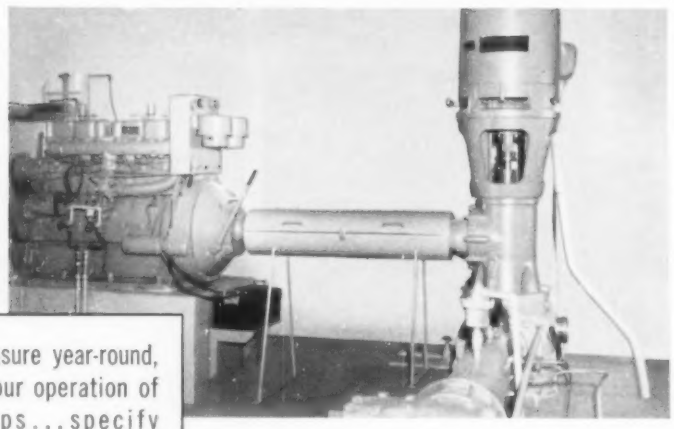

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tary Engineering from Pennsylvania State College; he was with Morris Knowles, Inc., Consulting Engineer, on water supply for fourteen years and has been water supply engineer with Consoer, Townsend and Associates, Chicago, for thirty years. Other phases of water supply, such as management, operation or public health, no doubt are also interesting.

Just recently the writer was notified by the American Water Works Association that he will be a life member after payment of dues for thirty years. It is quite inspiring and romantic to have followed many water supply projects from their inception to maturity and usefulness.

John A. Fulkman
Consoer, Townsend & Associates
Consulting Engineers
Chicago, Illinois

CONCRETE PAVEMENT TEST JOBS IN CONNECTICUT AND INDIANA

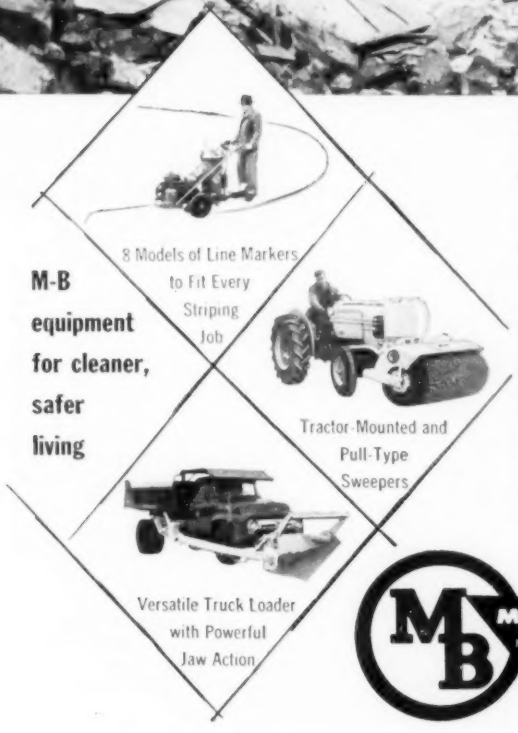
The first of the two reports in this bulletin gives the 23-year results of special tests and traffic on 8.35 miles of concrete pavement near Indianapolis, Ind. Special design features incorporated in 9 half-mile sections of pavement included different designs of joints and patterns of steel reinforcement. Seven other sections representative of the then standard design of concrete pavement in that state were interspersed among the specially designed test sections. The other report describes the design, construction, and four years of the life history of a concrete pavement test section in Conn. Object of the test was to study the relative performance of different designs of dowelled transverse joints. Copies of Bulletin 165 are available from Highway Research Board, 2101 Constitution, Washington, D. C., at $1 each.

CONTRACTS, SPECIFICATIONS AND LAW FOR ENGINEERS

This text is for advanced students of architectural and civil engineering and a reference for practicing engineers and contractors. The entire treatment, including the illustrations, is fairly simple and non-

what a payload!
so firm...
so big...
so fully packed!

It's a fact . . . the M-B Packer can give you full-capacity loads like this from your routes. Think of the time and money saved over old-fashioned methods of refuse and garbage collection. ▪ See the fast, safe, clean "push-out" rear unloading action. The same powerful packer plate that compacts the material pushes out the load completely with one movement. There is no time-consuming, messy manual clean-out of the body . . . no danger of the unit tipping on uneven ground. ▪ Notice, also, the *thorough* compacting job done by the M-B Packer. Garbage, leaves, debris, even bulky cartons . . . compressed solidly right to the top of the body. That means more tonnage per load . . . fewer trips to the dump or incinerator. Routes are finished faster and more blocks are covered each day. ▪ With M-B's foolproof, simple design, "downtime days" are practically eliminated and maintenance is fast and easy. There are no complicated, fussy hydraulic lines and valves . . . no intricate mechanisms to jam . . . just a powerful, top-to-bottom packer plate that squeezes the load to a solid, condensed mass like the one being dumped above.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Tractor-Mounted and Pull-Type Sweepers
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Simple design ▪ Controlled packing ▪ Greater safety ▪ Fits less expensive trucks ▪ Costs less to buy — less to operate ▪ Packs anything ▪ Simplified mounting ▪ Less downtime ▪ No counterweights needed ▪ Loads and unloads faster ▪ 12, 14, 16, 20 and 24 cu. yd. capacities ▪ New 38 cu. yd. trail-pack and container-loader-packer-system now available. Call your distributor now for full information!

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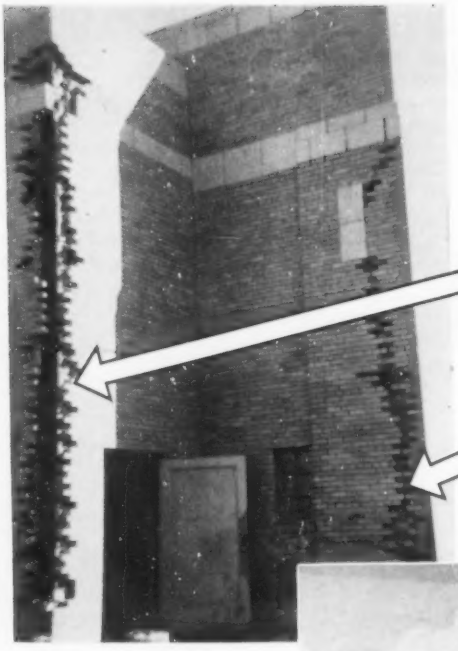
MANUFACTURERS OF QUALITY MUNICIPAL AND CONSTRUCTION EQUIPMENT *since* 1907



Water almost ruined this building

Costly plaster damage inside of building caused by water seeping through from cracked walls

Water entering through cracks in exterior walls of this expensive brick building caused corrosion of structural columns and beams, making brick walls bulge and crack.

Columns were coated and brick masonry relaid and repointed with DRYJOINT Pointing Mortar and entire building given one coat of THOROCLEAR invisible waterproofing.

Thousands of schools and hospital buildings need THOROCLEAR to keep water out of the masonry walls.

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legalistic. It begins with forthright and firm statements of legal principles and contracts, then goes into those practical situations where an engineer is most likely to encounter the applications of the principles. The book is written strictly from a practical legal and engineering point of view and it describes and illustrates sound modern practice in all aspects of contracts and specifications. The authors are Clarence W. Dunham, Rensselaer Polytechnic Institute, and Robert D. Young, Yale Law School. The book is $7.50 per copy and is available from McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y.

BRIDGES AND THEIR BUILDERS

The story of the Mackinac Straits Bridge and Tacoma's "Galloping Gertie" Bridge, as well as a history of bridge building is contained in this book by David B. Steinman and Sara Ruth Watson. Publishers are Dover Publications Inc., 920 Broadway, New York 10, N. Y., and the price per copy is $1.95.

TRAFFIC DESIGN OF PARKING GARAGES

This publication is the 1957 revised edition of "Traffic Design of Parking Garages." New parking garages built in the last ten years exceeded predictions. They played an important part in revitalizing urban areas. Open-walled single-purpose structures are accepted as a permanent and essential part of downtown building. New designs were developed, and old ones improved, such as the sloping floor; and there has been a rebirth of mechanical garages. Author is Edmund R. Ricker, Traffic Engineer, New Jersey Turnpike Authority. Write to The Eno Foundation For Highway Traffic Control, Saugatuck, Conn., for information on this book.

BETTER TRANSPORTATION FOR YOUR CITY

This handbook was prepared by the National Committee on Urban Transportation to help cities do a better job of transportation planning through systematic collection and analysis of basic facts. Techniques described are to guide the development of highway, transit and terminal improvements in a manner which will afford the public the best possible transportation service at the least possible cost. Information available from National Committee on Urban Transportation, 1346 Connecticut Ave., North West, Washington 6, D.C.

A NEW CONCEPT in ultra-clean sweeping is introduced by the new Tennant "100" Vacuumized Sweeper. In even the driest weather it sweeps extra-clean; no water spray . . . no mud streaks.

NO CLOUD OF DUST behind this sweeper! It stirs excitement instead of dust wherever it's shown. Picks up both heavy litter and fine dust. Special 540 sq. ft. filter catches dust particles as fine as 5 microns . . . invisible to the human eye!

LEAVES SPICK-AND-SPAN PATH 7'4" wide. Unretouched photo shows how vacuum-equipped brooms of the Tennant "100" set a new standard in clean sweeping. Gives results not possible before.

Why the new TENNANT 100 gets the dirt most sweepers miss

The revolutionary new TENNANT *Vacuumized* Sweeper gets the dirt that most conventional sweepers miss. Here's why this is possible:

Powerful broom-and-vacuum system instantly picks up *fine dust and dirt* . . . as well as heavy, bulky debris. Does NOT use water spray!

New type main broom adjusts to constant diameter. Assures uniform sweeping results during *entire* life of broom. You'll see the difference.

Direct-loading hopper fills from top without a conveyor! Automatically loads "heaping full"—well in excess of rated hopper capacity ($1\frac{3}{4}$ yds.).

Has no conveyor. Permits compact, easy-handling design and short 9'2" turning radius. Allows efficient, wide-range use in areas where larger conventional sweepers are impractical.

Write today *for complete details to:* G. H. Tennant Co., 755E N. Lilac Drive, Minneapolis 22, Minn.

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VACUUMIZED SWEEPERS

Power Sweepers | Traffic Line Erasers | Concrete Routers

SPECIALIZED MAINTENANCE EQUIPMENT

SPECIAL DELIVERY for liquids and gases in all branches of industry is assured with Kraloy Rigid Polyvinyl Chloride (normal and high impact) Plastic Pipe . . . with virtually no maintenance or policing. You install Kraloy PVC—and forget it. That's why millions of feet of Kraloy Plastic Pipe are in use today, because Kraloy PVC is inert and can never rust, rot, or corrode, is not subject to electrolytic action, handles abrasives, slurry and most Ph factors, is scale resistant. Superior flow characteristics (C factor = 150+) permit use of smaller diameters. Installation costs 50% less, due to light weight and ease of handling.

Write for complete information and literature.

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LOWEST COST SPACE CONTROL THROUGHOUT THE COMMUNITY

TIFA

Mosquitoes, Flies and Other Insect Pests Destroyed on Contact

On the dump, over pools, in suburbs, play areas, stockyards, TIFA gets the kill every time . . . at the lowest operating and maintenance cost. TIFA rapidly covers large areas with true clean fog, permeates smallest crevices, envelops and destroys all all insect pests. This efficiency with newest or older type insecticides, gives you a better insect control program for your community.

TODD INSECTICIDAL FOG APPLICATOR

BEST by TEST for over 13 years in Community Fly and Mosquito Programs

Carrying Underwriters' Listing Seal MH 4162

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TODD SHIPYARDS CORPORATION

HEADQUARTERS: Columbia and Halleck Streets, Brooklyn 31, N.Y.

PLANT: Green's Bayou, Houston 15, Texas

Speller Award in Corrosion Engineering to Robert J. Kuhn

Mr. Kuhn

The Frank Newman Speller award in corrosion engineering has been awarded Robert J. Kuhn, consulting engineer of New Orleans, La. The award was made at the annual meeting of the National Association of Corrosion Engineers held in San Francisco in March. Mr. Kuhn, an originator and leader in cathodic protection, is the author of more than forty technical papers in corrosion prevention and a member of numerous professional societies.

NEWS OF ENGINEERS

Rochester and Goodell Engineers, Inc., Salem, Illinois, has elected WARREN B. GOODELL, Chairman of the Board; FRANK M. ROCHESTER, President; COLONEL WARREN HELIG, Vice-President and General Manager; HOWARD BATEMAN, Vice-President and Highway Consultant; EARL MOLDOVAN, Secretary and Chief Engineer; WILLIAM SPAIN, Treasurer and Office Engineer. The firm is engaged on Interstate Highway and Toll Highway work in Illinois and Florida.

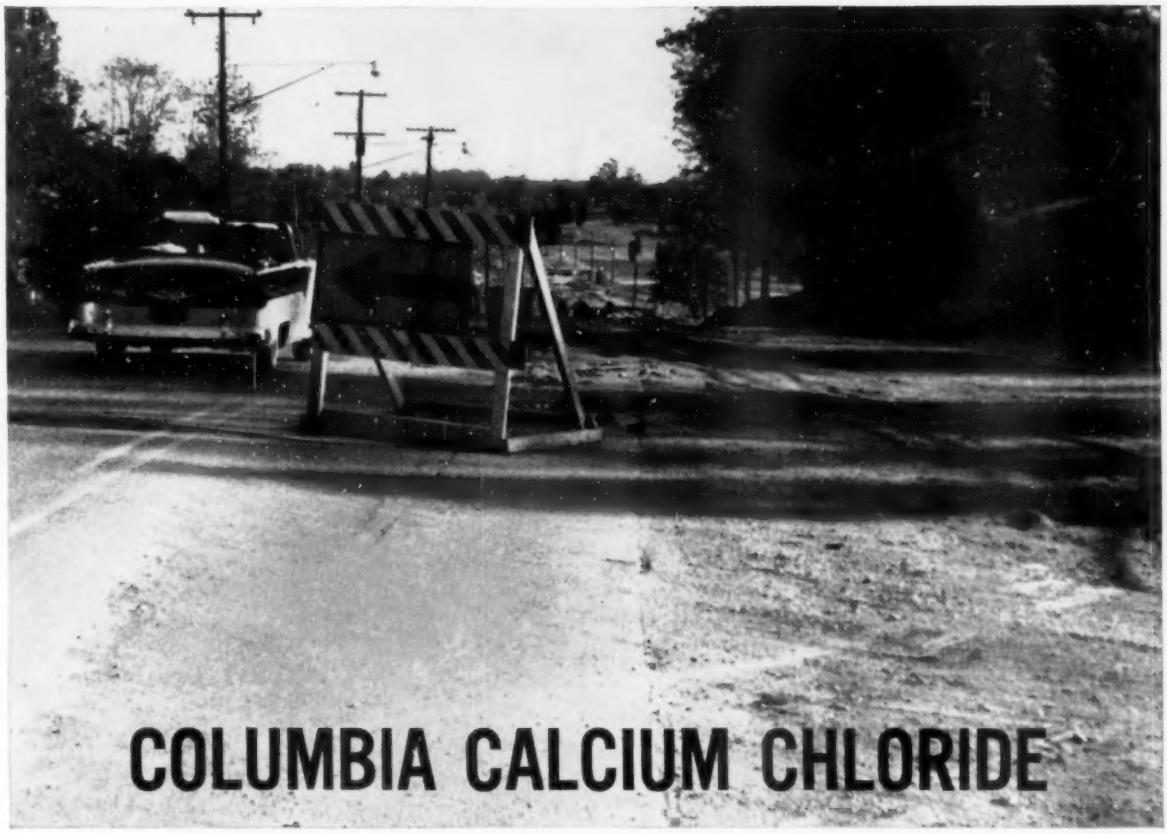
FRANK E. DOLSON and HERBERT O. HARTUNG have been elected vice-presidents of the St. Louis County Water Co. of which W. VICTOR WEIR is president.

HARLEY C. BOEKE, formerly Director of Public Utilities of Rock Island, Ill., is now Commissioner of Public Works of Lockport, N. Y.

DANIEL KOFFLER & ASSOCIATES have opened an office at Du Pont Blvd. & Washington Ave., New Castle, Del., and will do consulting engineering in the bridge, structural, mechanical, sanitary, parking and allied fields. Allan Gavin, Morton Batten and Gerald Palersky are associates.

Civil Engineer Available

Engineer with two years' experience in design of structures, foundations and conveyors. Civil Engineering degree and eligible for professional license. Currently employed by leading industrial engineering firm. Prefers to locate in the East. Write to: Box 5-1, care of Public Works Magazine, 200 So. Broad St., Ridgewood, N. J.



COLUMBIA CALCIUM CHLORIDE

KEEPS DUST DOWN AND ROADS UP

Dust caused by traffic and by your construction and maintenance work creates public relations problems. Municipalities, nearby residents, and drivers don't like it. Your own crews don't like it. Efficiency goes down, and the chances of costly accidents increase.

Road and construction dust can be controlled very inexpensively with Columbia Calcium Chloride. This "thirsty" chemical absorbs moisture from the air to keep soil slightly damp. In addition to "sweetening" applications on road surfaces, you'll find it pays to spread Columbia Calcium Chloride through and immediately around working areas, in parking spots, and over detours and by-passes.

Heavier seasonal traffic means your attention will be on improving shoulders, too. Again, Columbia Calcium Chloride application produces solidly stabilized shoulders, safe for bearing of traffic and off-road parking.

When major reconstruction of roads or new road building is on your schedule, don't overlook applying Columbia Calcium Chloride to dense-graded aggregate bases. Effective stabilization is vital here.

You'll be using this versatile chemical product throughout the summer. Why not contact your nearest Columbia-Southern District Office now and arrange for quick delivery. For both product and service, specify Columbia-Southern.

Available in two forms—
High Test Flake (94-97% $CaCl_2$)
and Regular Flake (77-80% $CaCl_2$)

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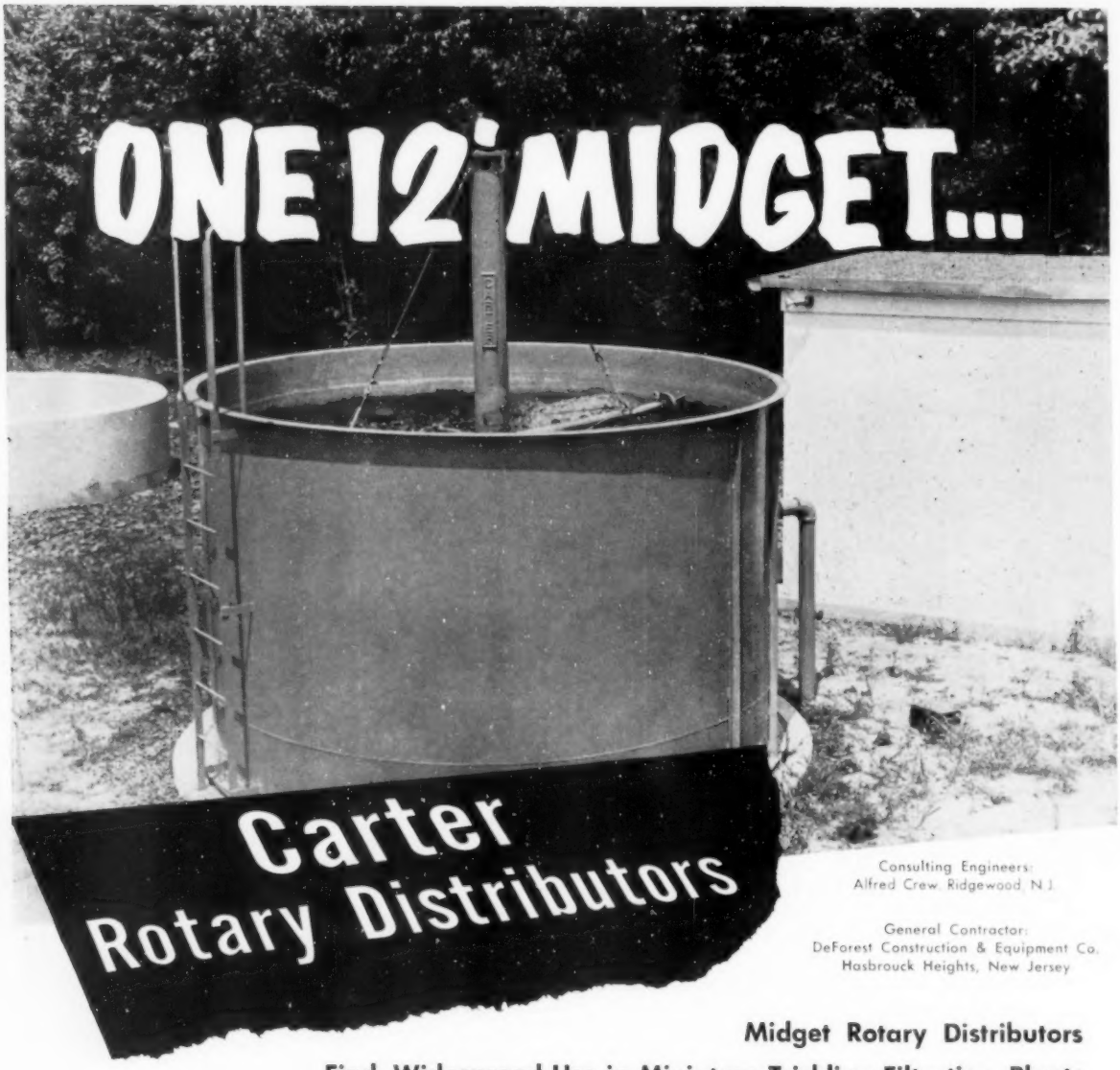
A Subsidiary of Pittsburgh Plate Glass Company

One Gateway Center, Pittsburgh 22, Pennsylvania DISTRICT OFFICES: Cincinnati, Charlotte, Chicago Cleveland, Boston, New York, St. Louis, Minneapolis, New Orleans, Dallas, Houston, Pittsburgh Philadelphia, San Francisco IN CANADA: Standard Chemical Limited



Consulting Engineers:
Alfred Crew, Ridgewood, N.J.

General Contractor:
DeForest Construction & Equipment Co.
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Midget Rotary Distributors Find Widespread Use in Miniature Trickling Filtration Plants

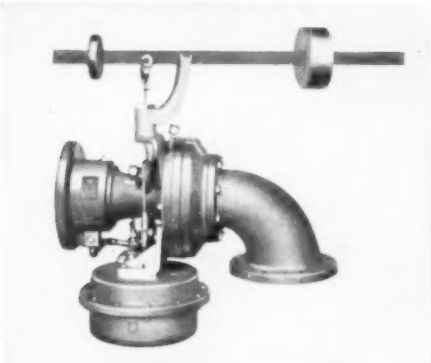
The current trend toward dispersion of suburban shopping centers, hotels, motels, highway restaurants, and other commercial establishments has served to emphasize the importance of the role being filled by small treatment plants—in solving problems of domestic sewage discharges outside the reach of municipal sewerage systems. This increased emphasis on efficient handling of low flows has resulted in equipment specifically suited to the small treatment plant . . . equipment such as the 12′ Carter Rotary Distributor shown here in a typical miniature primary plant handling wastes from a busy highway restaurant.

In every respect, these midget units receive all the care and skill that goes into major equipment. Proven designs, skillful fabrication and precision machining of all vital parts . . . reducing hydraulic losses to a minimum . . . and assuring continuous, troublefree operation under low head conditions. Everything is made as simple and fool-proof as possible, so that operational and maintenance requirements can be handled by even unskilled personnel.

Write Today for Free Bulletin 5210

Ralph B. Carter Company 210 ATLANTIC STREET HACKENSACK, NEW JERSEY

SIMPLEX TYPE S RATE OF FLOW CONTROLLER
Direct venturi-actuated. Self-contained . . . operates when all power sources fail.



OVER 5,000 UNITS IN SERVICE PROVE SIMPLEX FILTER CONTROLLERS YOUR BEST VALUE!

Simplex economy and accuracy demonstrated by 25 years' dependability

Simplest way to make sure you're specifying the best: check some installations. Investigate all types and makes of filter controllers. Find out which give the best control . . . which the best balance of initial vs. operating and maintenance costs.

Include the *hidden extras* in total installed cost: space-wasting straight pipe runs before or after the unit; expensive electric or pneumatic positioners with additional circuits. You'll find that venturi-actuated Simplex controllers cut costs because they're completely self-contained . . . require no extras.

Dig into maintenance costs. You'll find direct-acting Simplex controllers give long years of trouble-free service. They're self-operating . . . need no positioners, have fewer moving parts, virtually friction-free action.

Take a second look at performance. With Simplex you'll find low head loss that saves on pumping. And straight-line accuracy to the end point that makes for longer filter runs.

Simplex can help you save money on your next expansion or your new plant. Ask us to prove it!

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Send me new Technical Bulletin 900 that gives valuable design and performance data on Filter Controllers and Master Control Systems.

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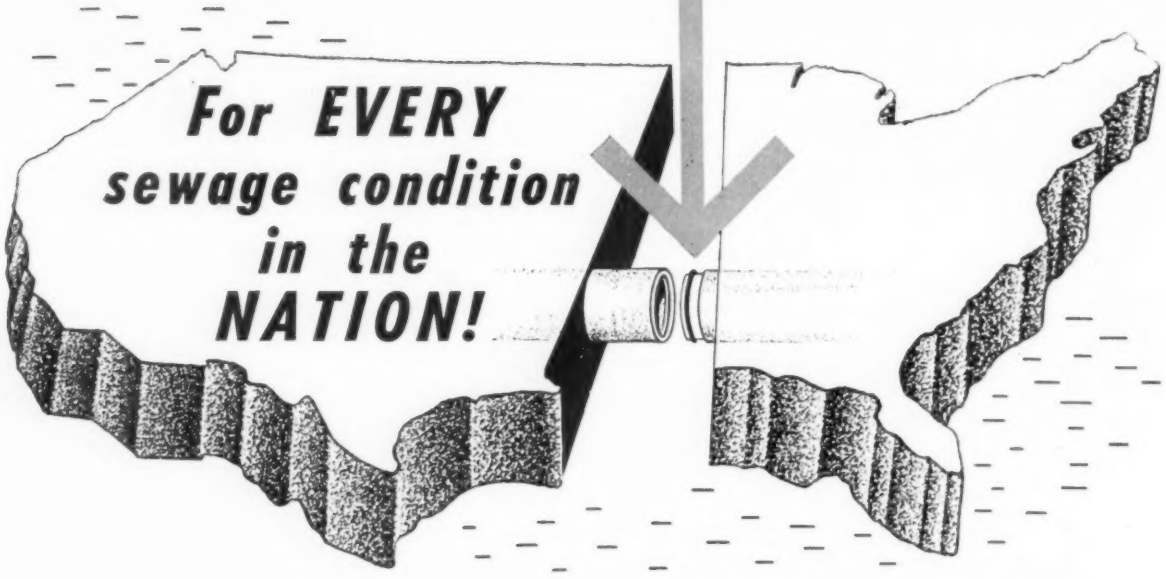
Solved the SEWER PIPE LEAKAGE PROBLEM . . .



PRESS SEAL GASKETS have the answer!

Today more cities than ever before throughout the United States and Canada are installing Press Seal Gaskets on new sewer pipes. Profitable?—you bet. Lower costs for years to come because of the lasting seal, hence reduced replacement cost in your city's sewage pipe system.

Available in

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2. **Neoprene for acid content sewage.**
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PRESS SEAL GASKET CORPORATION OF CANADA — KITCHENER, ONTARIO

The more difficult your sewage odor or treatment problems the more startling and definite the proof...

Cloroben is at least TWICE as effective as other products

states authoritative Millburn, New Jersey report, appearing in April, 1958 issue of Public Works.

Well worth your attention is the complete Millburn history, typical of the reports sent us by professional sanitation engineers and sewage treatment plant operators.

Located along the Watchung Hills in Union County, Millburn is a fine suburban community. When vile sewage odors began to permeate the area in 1953, the residents demanded relief. During the summer of 1954 CLOROBEN was first introduced into the sewage collection system, and immediately stopped odor complaints. The CLOROBEN treatment was continued through 1954 and 1955 with excellent results. All odors were effectively controlled in lift stations, force mains and low gradient sewer lines.

Then, in 1956, various emulsifiable chlorinated benzenes were offered the township. Advertising claims indicated these products were almost identical to CLOROBEN. In price they compared favorably. So, in 1956 competitive bids were required, specifying CLOROBEN or equal. And, the contract was awarded to the lowest bidder.

Right after the change from CLOROBEN to the cheaper substitute, odor complaints began coming in. The amount of the chlorinated benzene used was doubled, then quadrupled. Everything else possible was done. Low gradient lines were flushed periodically, and lift station wet-wells cleaned weekly. But, the odor complaints persisted and increased. Sulphides and pH determinations were made throughout the system. Odorous areas invariably showed sulphides at 0.3 ppm or more, with pH below 7.5. The situation got even worse right up to July 31, 1957, when use of the cheap chlorobenzene substitute was stopped. On the following day CLOROBEN was reinstated.

Results were startling. By mid-afternoon sulphides had been reduced 50%, pH was back to 7.5. By evening sulphides in lift stations decreased by as much as 80%. And, no further odor complaints have been received since! Concrete and positive proof of the superiority of CLOROBEN in controlling odors and suppressing sulphide formations in sewage!

To effectively control odors and suppress sulphide formation, no product of its kind compares to CLOROBEN in safety, efficiency, and economy. And, only up-sewer treatment with CLOROBEN provides a non-septic, stabilized influent at the treatment plant for efficient operation.

Remember, CLOROBEN is an exclusive formula, the only chemical product of its kind. So, specify CLOROBEN. Not CLOROBEN or equal.

Because CLOROBEN has no equal.

Yours on Request: Authoritative Technical Bulletin, describing CLOROBEN applications in up-sewer treatment, sewage treatment plant, septic tanks, cesspools, chemical toilets, and industrial wastes. Write "CLOROBEN" on postcard or letterhead for your copy, sent you promptly without cost.

Write Dept. PW-5

CLOROBEN CHEMICAL CORPORATION

115 Jacobus Avenue, South Kearny, New Jersey Subsidiary of Standard Chlorine Chemical Co., Inc.

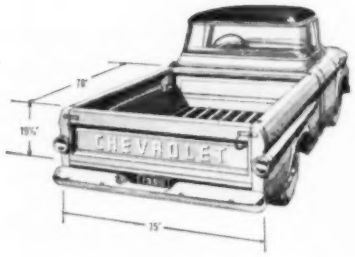
Just out! The newest in pickups!

NEW FLEETSIDE BY CHEVROLET

Here's the new sweetheart of the Task-Force fleet, Chevrolet's new Fleetside pickup! No truck has ever been better to look at . . . or better for your business.

Long, sweeping lines, graceful body contours . . . *new* truck appearance that's fleet, dashing and completely modern! Yet there's even more to the new Chevrolet Fleetside than the striking beauty that first meets your eye. There's *size*, for instance: extra room inside to pack many additional cubic feet of payload. And with double-walled lower side panels, durable hardwood floor, and solidly constructed full-width tailgate, the new Fleetside is the toughest of pickup bodies, too! A new adjustable latch keeps graintight tailgate free from rattles.

Here's a new high in hard-working utility, matched by new styling that makes you stand out on any street. See the new Fleetside at your Chevrolet dealer's now! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.



More load space than any other comparable low-priced pickup. In lengths of either 78 inches or 98* inches and a full six feet in width, this new body actually provides 50% more cubic capacity than the conventional pickup box! **Optional at extra cost.*

Plenty of work-whipping hustle and muscle. Your choice of two great engines—standard 145-h.p. Thriftmaster 6 or optional at extra cost 160-h.p. Trademaster V8. And truck-engineered chassis components will take all the abuse your most bruising hauls can give them!

CHEVROLET **CHEVROLET TASK·FORCE TRUCKS**

. . . with the greatest of ease

CUSTOMER

It fits in our budget with greatest of ease,
With savings at which no smart buyer can sneeze,
Low cost plus long life and best service he sees
Mean premium pipe at low pay.

CONSULTANT

It matches our plans with the greatest of ease,
Complete with bends, shorts, Y's, adapters and T's,
Designed for what pressure or backload we please,
The pipe we are proud to OK.

CONTRACTOR

It goes in the ground with the greatest of ease,
Is rapidly jointed come storm, heat or freeze,
No caulk, bolt or weld—installation's a breeze,
And backfilled the very same day.

OPERATOR

It carries full pressure with greatest of ease,
Corrosion and tubercles never displease,
High maintenance costs never put on the squeeze
With uncalled for bills to defray.

LOCK JOINT CONCRETE PRESSURE PIPE *for this* QUARTET!

CHORUS

It fills all our needs with the greatest of ease,
It's thrifty yet safe everybody agrees,
No wonder we all say, "No substitutes, please!"
When Lock Joint's the best pipe to lay.

LOCK JOINT PIPE CO.

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col • Detroit, Mich.
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Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous

INCINERATOR MAINTENANCE CAN BE CUT!

Here is Plibrico's method for reducing costs in two major areas of maintenance expense

THE FURNACE LINING

Greatest potential source of maintenance expense is the lining . . . and you can see why, for it's subjected to the greatest punishment. Temperature fluctuations cause lining expansion and contraction; sudden inrushes of cold air during charging cause thermal shock; and there's abrasion to contend with too. These destructive forces attack an ordinary lining of fire brick where it's weakest . . . in the joints . . . hastening failure.

There are no joints in a Plibrico lining. What's more a Plibrico lining has a positive anchorage system holding it securely in place. Hence that weakness, that cause of premature failure, that source of maintenance expense is eliminated.

THE STOKER

You know the more complex a thing is, the greater are its chances of failure, the more difficult and expensive it is to repair. The Combustikator stoker is simplicity itself. The ruggedly built grate assembly works as a single unit, driven one direction by a motor through simple mechanical linkage, and returned by husky power springs. Nothing complicated, but how effective! That's why it can be your answer to high stoker maintenance. You'll get a bonus saving with the Combustikator, too, for it provides automatic ash discharge, cutting ash handling costs.

May we place all the facts before you?

Plibrico INCINERATORS

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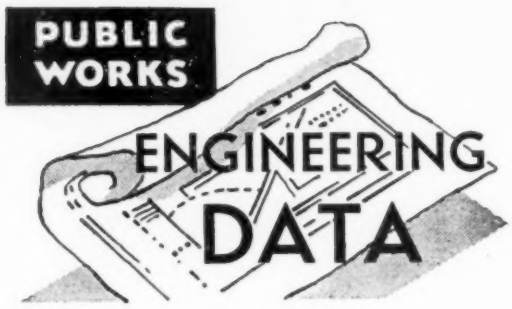

Town Contracts for Refuse Collection but Provides Equipment

A possible solution to the problem of refuse collection has been tried out by the Town of West Hartford, Conn., according to a report by Donald H. Blatt, Town Manager. Invitations for bids were issued late in 1957 for the collection of all types of refuse from residences, businesses, municipal buildings and schools for the population of about 57,000. The collection is of wrapped garbage and incinerator refuse in one container, and the only separation is noncombustible from combustible materials.

The specifications covered collection schedules, personnel, equipment, handling of service and complaints, insurance, and performance bond. Three bids were received. The lowest bid was accepted at $322,980 for the 18-month period. The contract provides that the collecting agency shall furnish a performance bond; public liability insurance; property damage insurance; and workmen's compensation insurance. The town furnishes all necessary trucks for collection and hauling and all materials to do the work, including gasoline, oil, grease, tires, tubes and other repair parts. Collection will be from backyards and both collection and incineration will be on a 5-day a week basis.

Disposal is at the town-owned incinerator, and the town provides all maintenance and upkeep for the incinerator and surrounding grounds. After a year, an adjustment upward or downward may be made in the contract price on the basis of the Consumer Price Index of the Bureau of Labor Statistics.

Sewage Treatment Plant Operation Data, Alexandria Sanitation Authority

The annual report of the Alexandria, Va., Sanitation Authority for the year ending Sept. 30, 1957, gives data on sludge gas production as follows: A total of 36 million cubic feet of gas, representing a production of 1.16 cubic feet per capita per day, or enough to provide annual heating and hot water service for 111 single family residences, was produced during the year. Of this amount, 8.5 million cubic feet, having a value of approximately $4,650, was utilized as a fuel for the engines and 7.2 million cubic feet, having a value of approximately $3,950, was utilized as a fuel for heating. The balance was burned to waste.

Sludge dewatering facilities were placed in operation in Feb., 1957. During the remainder of the year, a total of 3,171 tons of sludge cake, containing an average moisture content of 75.5 percent and representing an average filter yield of 6.6 pounds per square foot per hour (dry solids basis), were produced.

From February through April, the sludge was con-

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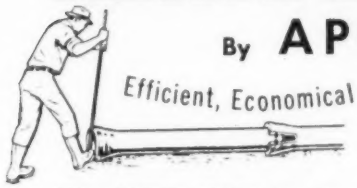
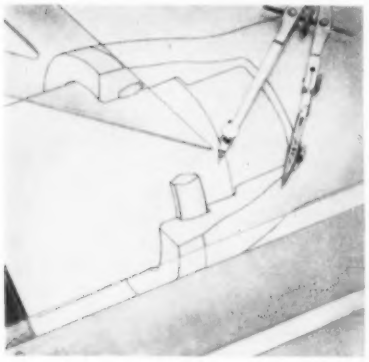
ALTITE JOINT

By APCO

Efficient, Economical and Fool Proof—



The **ALTITE JOINT** has been subjected to a series of rigid tests much more severe than are encountered under the most extreme installation and service conditions in the field. Even under extreme conditions, this joint is so simple to install—you could hardly go wrong if you tried.



Underwriters Approved
Patent Applied For.

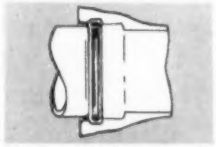
For efficiency, Economy and Simplicity—

Order ALTITE For Your Next Job

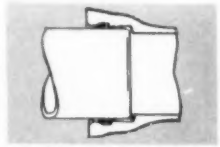
Four Operations As Simple As Falling Off a Log—

Insert Rubber gasket in bell end of pipe — you can't put it in wrong — A child can do it.

Wipe on a small amount of special lubricant—This reduces friction.



Insert plain beveled end of pipe — there are no grooves, ridges or tips on gasket to interfere with smooth insertion.



Small amount of pressure required to force plain end to bottom of socket—Your simple, time saving joint is completed.

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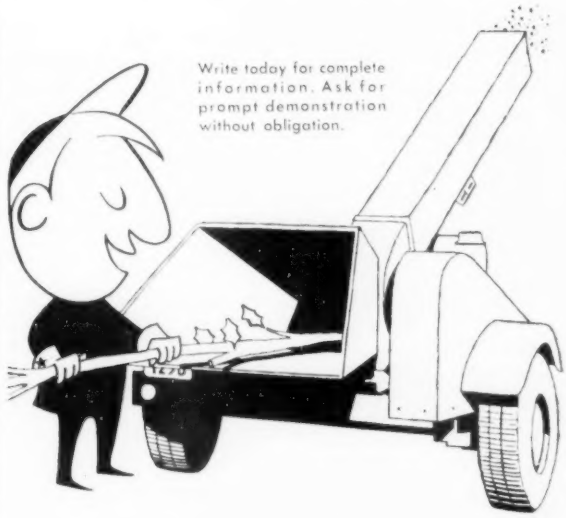
TOP SPEED—a specially designed power unit provides faster, more uniform chipping action. **ABSOLUTE SAFETY**—positive-locking, tapered blades and wedges. **BULK FEED**—a ravenous appetite for brush up to 6" diameter. **LOWER MAINTENANCE**—thanks to simplicity of design, fewer moving parts. **SUPERIOR TRACKING**—underslung engine and axle lowers center of gravity. **CUSTOM TOOL COMPARTMENT**—to protect servicing equipment. **SERVICE AND ECONOMY**—proven by the largest tree company in the world.



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MOBILITY . . .
CAPACITY . . .
with a
HENRY

TRACTOR FORK LIFT

No doubt about it . . . a newly-designed HENRY Tractor Fork Lift attached to big-tire Utility Tractors adds more power, traction, mobility . . . to materials handling jobs. Here's the Lift that's tops for economy too!

Built with a new sub-frame design for equalized weight distribution, the large tractor tires give more ground clearance and traction, and greater cushioned mobility regardless of ground conditions.

Choose one of the four models and 8 attachments for your operations now. See your nearby equipment dealer who sells the best . . . HENRY!

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TOPEKA, KANSAS

YOU CAN DO IT BETTER WITH A HENRY

ditioned for dewatering by the addition of ferric chloride at an average feed rate of 4.6 percent on a dry solids basis. Operation during this period resulted in a production of 1,181 tons of sludge cake, containing an average moisture content of 75.2 percent and representing an average filter yield of 5.3 pounds per square foot per hour, dry solids basis. Commencing in May, lime was also added as a conditioning agent at an average feed rate of 6.1 percent (CaO). This resulted in a decrease in the average feed rate of ferric chloride from 4.6 percent to 2.7 percent, dry solids basis, and in an increase in the filter yield from 5.3 to 7.4 pounds per square foot per hour, also on a dry solids basis. Operation during the period May through September resulted in a production of 1,990 tons of sludge cake containing an average moisture content of 75.6 percent.

The trickling filters used at this plant have a hydraulic loading of 14.5 mgad and an organic loading of 2348 lbs. per acre-foot per day of BOD. Removal of BOD was 69.1 percent on the basis of the raw sewage strength for the entire year, but increased during the latter part of the year to 77.3 percent. There are three filters, each 160 ft. in diameter and 4.25 ft. deep.

There are 11.9 miles of sewers. Cost of operation and maintenance, including metering stations, was $190.76 per mile. Two sewage pumping stations are operated. Their operation and maintenance amounted to $190.05 per million gallons of installed pumping capacity.

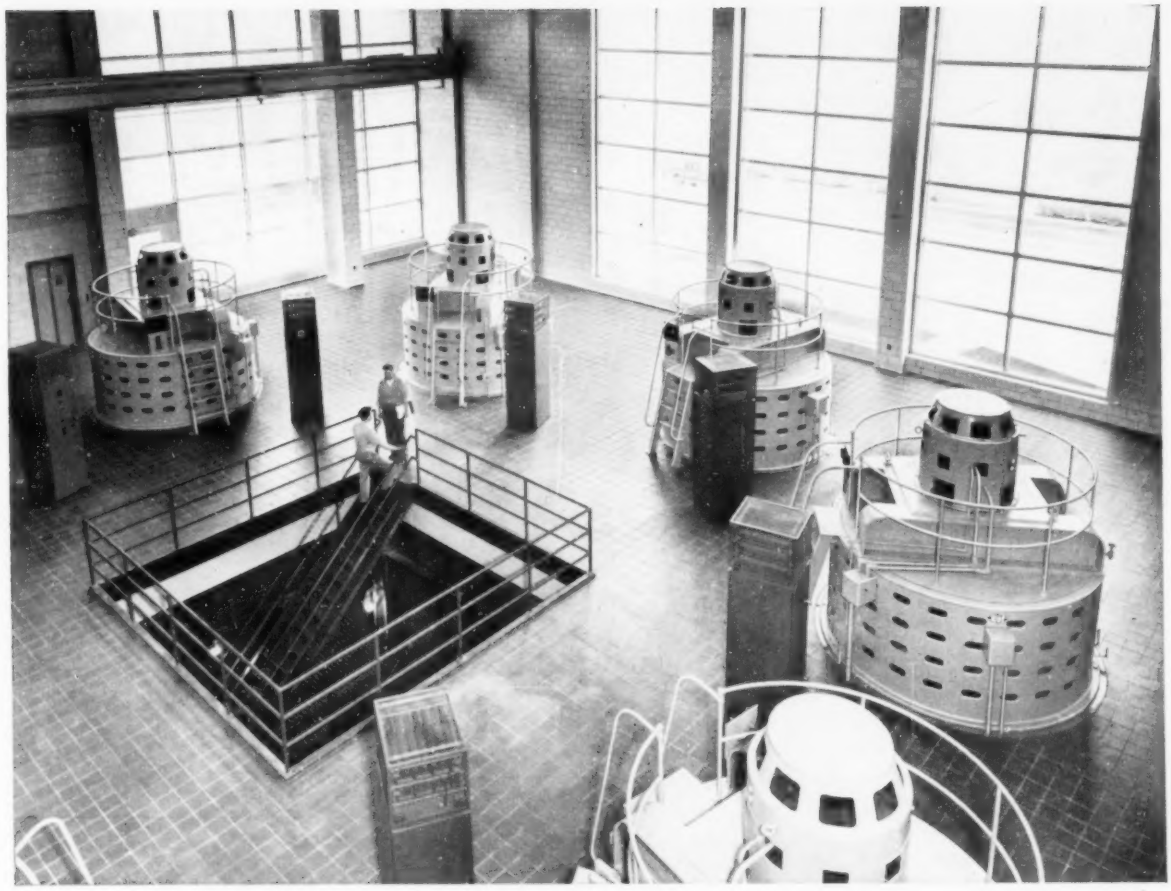
Communications System and Toll Collection Equipment

The Illinois State Toll Highway Commission has approved a contract of $898,798 for a micro-wave communications system with Radio Corporation of America. It will service police communications, maintenance and toll collection operations and other administrative requirements. The system will make it possible to have each day's revenue and traffic at the toll plazas reported to the administration building the the following day.

A contract for the toll collection equipment and toll plazas was awarded to the Electronic Signal Corp., for $1,510,350. This equipment will record each toll transaction and will provide a method of auditing tolls. The contract covers the manufacture and installation of complicated electronic equipment as well as the maintenance of the equipment for one year.

Dow Presents Highway Program Film

A motion picture aimed at creating public understanding of the $51-billion Federal Interstate Highway program has been released by The Dow Chemical Company. The film "Highway Hearing", was developed in cooperation with highway authorities at the national, state and local levels. It is designed to help the public understand the aims and benefits of the nation-wide program. The film portrays a typical public hearing in a typical community and highlights the reactions of the residents to the proposed local highway situation in terms of their personal interests. The film will be available for local showings before civic, church, service and other adult groups as well as in schools and colleges. It also is designed for public service television showing. The film includes a segment, called "Highway Challenge" which can be made available for specialized showings. For information on this film write Dave Coslett, Dow Chemical Co., Midland, Mich.



Here's how Detroit got flood-busting pump power for Storm Water Sewer System

Extensive rainstorm flood damage had been a problem that 150,000 residents of the Fox Creek District of Detroit faced each year. Existing storm sewers and pumping stations were recognized as being inadequate.

To end this situation, Detroit city engineers started a long-range area program. It included the installation of a new large storm water sewer system backed up by a series of pumping stations capable of pumping an enormous quantity of water, *fast!*

Will Handle 30,000 Gallons a Second

The Freud Storm Water Pumping Station shown above is the third to be completed in the new system. Eventually this station will handle up to 30,000 gallons per second with the eight huge pumps installed there.

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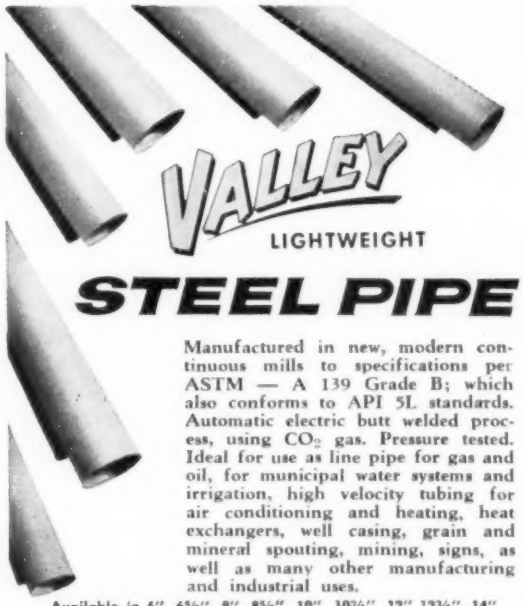

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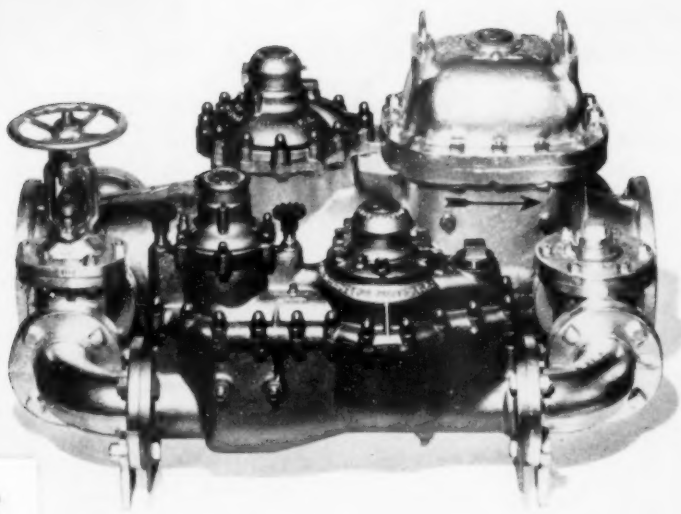

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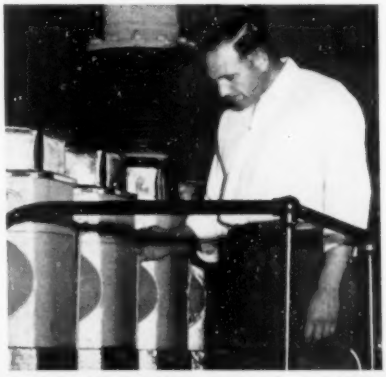
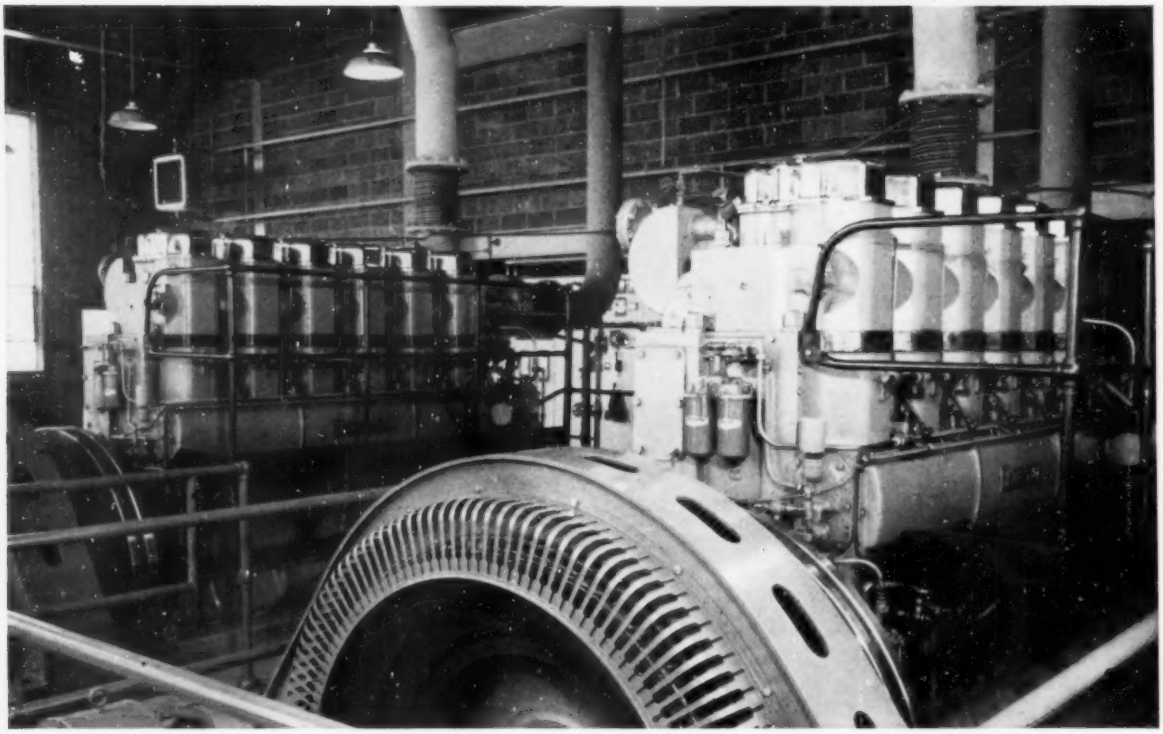
Manager, Municipal Power Plant,
City of Barnesville, Minn.





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* **PROJECT:** For City of Knoxville, Tenn., Riverfront-Willow Ave. storm and sanitary sewers.

ENGINEERS: H. R. Neal, City Engineer, and Roy I. Gentry, Service Director.

CONTRACTORS: Division A—Harrison Construction Company, Alcoa, Tenn. Division B—Blont Brothers Construction Company, Montgomery, Ala.

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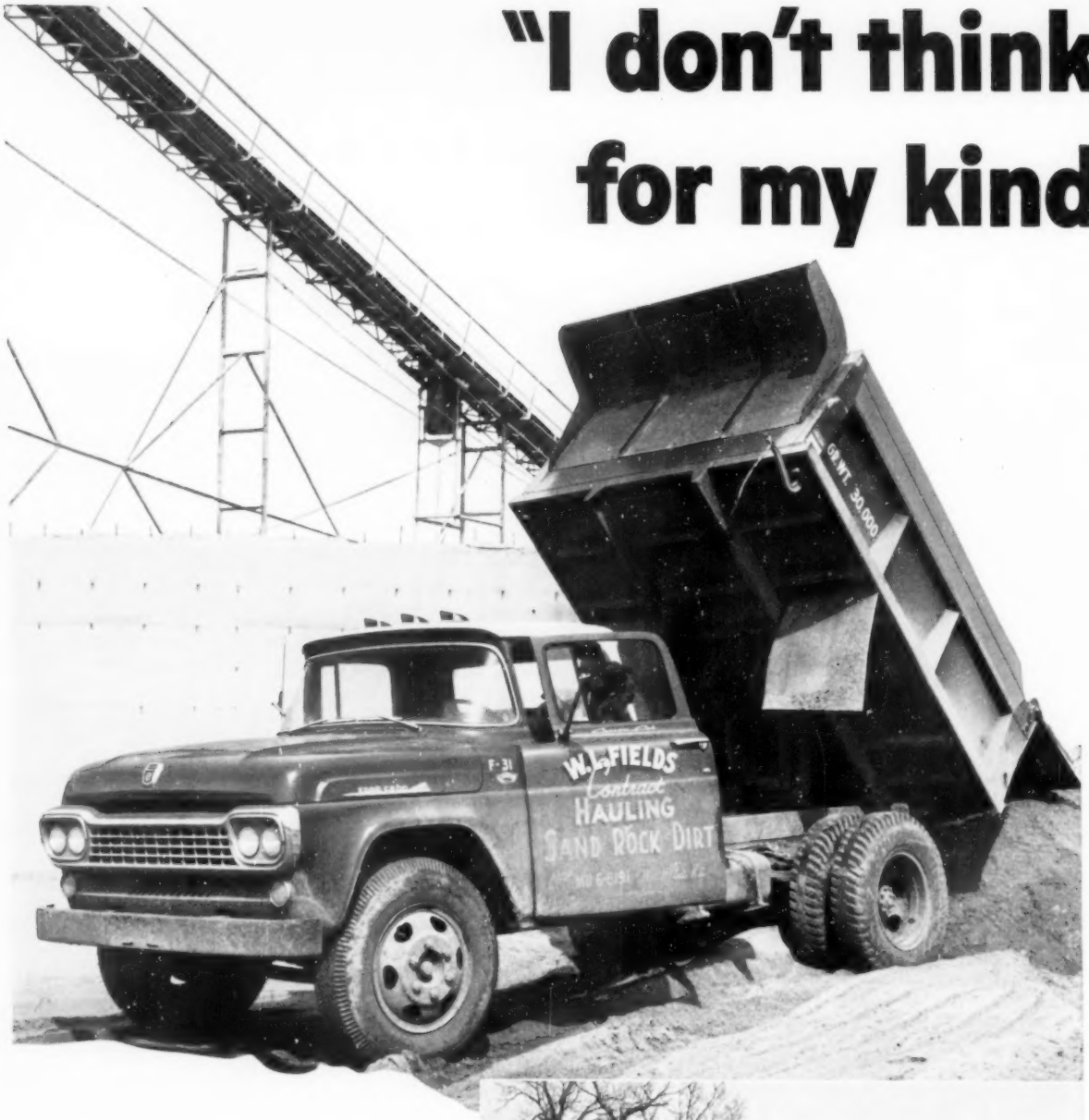

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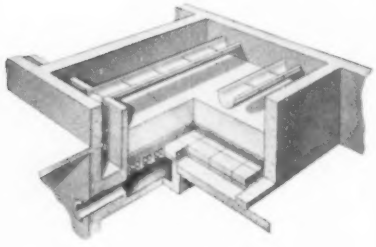

Filter unit showing Leopold Filter Bottom and Leopold Fiberglass-Reinforced Plastic Wash Troughs

Performance Proved in over 375 plants with a daily capacity of more than 2¾ billion gallons!

In this design, laterals and distributing blocks form a permanent unit that assures equal filtration and uniform wash distribution with low loss of head. Made of de-aired fire clay—vitrified and salt glazed—the blocks can't corrode, won't absorb water, are acid and alkali resistant, and are not subject to tuberculation.

In addition, the Leopold Filter Bottom needs only a shallow depth of small-sized filter gravel, does not require supporting concrete structures, and is the only design providing a fixed and controlled secondary backwash.

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LEGAL ASPECTS OF PUBLIC WORKS

MELVIN NORD, Dr. Eng. Sci., LL.B.

Siren Song

Township of Hillside v. Sternin, 136 Atl. (2d) 265, a New Jersey case decided Nov. 25, 1957, was an action by a township to recover monetary loss suffered by it as a result of a contractor's failure to enter into a formal contract for public work which had been awarded to him pursuant to his bid.

The township desired to install two sirens on schools. The cost was such as to bring it within the statute requiring public advertisement for bids, and award to the lowest responsible bidder.

In compliance with the statute, a public notice soliciting sealed bids was inserted in certain newspapers. Among one of the conditions specifically provided in the notice was that a certified check for 10 percent of the amount bid was to accompany each proposal.

Sternin submitted a bid at the request of a public official, without having any knowledge of the requirement of a certified check. His bid therefore contained no check. His figure was $1,087.25, which was $1,544.75 lower than that of his nearest competitor, and the contract was awarded to him. However he refused to execute the written agreement, maintaining that the bid was the result of his mistaken belief that the work to be done was the same as that which had been called for on an earlier occasion in 1955, and that he had never seen the new and more demanding specifications relating to the erection of these particular sirens. He also contended that his bid was invalid because the check did not accompany it.

Finally, the contract was awarded to the next lowest bidder, and Sternin was sued for the difference.

In the suit, the municipality claimed that it had the power to *waive* the requirement of the certified check, since the statute did not require it. However, the court held, on the ground of public policy, that a bid which does not meet the terms of the notice is invalid as a bid. The municipality is not allowed subsequently to waive any requirements, because this prevents the bidders from being on a true competitive basis, as required by the statute.

It should also be observed that even from this theory, the bid should have been held to be void on straight contract principles, in view of the obvious mistake in it, since it was off by 60 percent.

A Maverick Underground Parking Garage

Zachry v. City of San Antonio, 305 S. W. (2d) 558, a Texas case decided June 5, 1957, involved the validity of a 40-year lease by a city to an individual for a portion of a city park, for the construction and operation of an underground parking garage near the park.

Shortly after the lease was entered into between the City of San Antonio and Zachry, Mrs. Rena Maverick Green and others filed suit to try title, alleging that they were the heirs of Samuel A. Maverick who, more than 100 years earlier, had dedicated the land upon which Travis Park was located for the use of the public as a public park or square; that the dedication was made in such manner that the park would revert to the dedicator, his heirs and assigns, should the land cease to be used as a public park; and that therefore title had reverted to Mrs. Green and the others. In that suit, judgment was against Mrs. Green and for the City as owner of the land.

In that case, the City had made common cause with Zachry in upholding the validity of the lease. In the *present* suit, however, the City sought to *cancel* the lease, on the ground that the land had been dedicated to public use for more

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than 100 years as a city park, that there never was any abandonment of the park, and that the use of the park could not validly be diverted to an inconsistent use.

One of the defenses offered, besides the claim of abandonment of its use as a park, was that the City owned Travis Park in a proprietary capacity, and that it could therefore deal with the land as a private owner. However, the court held that whether or not the City held the land in a proprietary capacity was irrelevant, and that land dedicated to a public use could not be diverted to an inconsistent use. Thus, the lease was cancelled. This was a 2-2 decision, and as a result, the lower court's decision to this effect was automatically upheld.

An Overloaded (Former) Bridge

There once was a bridge over Marrowbone Creek. Defendant drove over it. Then there was none.

This may not be poetry, but it has feeling.

Commonwealth of Kentucky v. Ragland Potter Co., 305 S. W. (2d) 915, a Kentucky case decided Oct. 11, 1957, was an action by the State Highway Department for $11,000 damages to a highway bridge, a 45 year old span of 270 feet which collapsed when defendant drove an eight-ton truck carrying a two ton load onto the bridge, despite a posted five ton limit.

At the trial, the defendant showed that it had gotten away with the same stunt just a few hours before, without any collapse of the bridge. There was also some conflicting testimony about whether or not the truck, on the final trip, had hit a certain post in the bridge.

The case was sent to the jury, over the objection of the Highway Department. According to the latter, there was no need for a jury determination of fact; that the defendant was *as a matter of law* negligent because it had overloaded the bridge. The jury failed to put two and two together (or more precisely, they failed to put eight and two together, and then substract five). They gave a verdict for the defendant.

On appeal, the jury verdict was upheld. The court said there was no way to tell whether the bridge collapsed because of the overload or for some other reason.

The whole thing remains a great mystery. Nobody knows, especially the judges and the jury, why the bridge collapsed. But everybody knows the bridge that once was, is no more.

Liability at a Sewage Plant

Cloyes v. Township of Delaware, 23 N.J. 324; 129 Atl. (2d) 1, a New Jersey case decided February 4, 1957, was an action for the wrongful death of a 3-year old boy against a New Jersey township. The boy drowned in an open sedimentation tank of a sewage disposal plant operated by the defendant municipality on a utility basis by the imposition of sewer charges to users.

The sewage disposal plant was enclosed by a chain link fence. The boy entered the premises by crawling through an opening of 18 inches beneath the gate. As initially erected, the space beneath the gate was too small to permit a child to enter, but erosion of the soil had caused the enlargement.

The issue was whether the activity was governmental or proprietary, since if it were governmental, the township would be immune from tort liability.

The court said that sewage disposal is not one of the public services anciently furnished by local government, nor is it uniformly furnished today. In some places, it is provided by private utility companies. Although a municipality is *authorized* to provide for sewage disposal, there is no *general duty* to provide it. Thus, the court held that the activity was proprietary, and that the township therefore had no immunity from tort liability.

As indicated in 57 A.L.R. (2d) 1336, the courts are divided on this question. The courts of New Jersey, Missouri, and New Mexico have held sewage disposal to be a proprietary activity. The courts of Georgia, Pennsylvania, Texas, and Wisconsin have held it to be governmental. However, it is held even in the latter states that the municipality can be held liable for maintaining a *nuisance* in connection with a sewage disposal plant.

The Case of the Liquidated Damages; Or: Who's on Firth?

The case of Goodwin v. Village of Firth, 319 Pac. (2d) 970, an Idaho case decided Jan. 16, 1958, was an action against the Village of Firth for the balance due under a contract for installation of a sewer system, in which the Village cross-complained for the cost of re-laying the sewer line.

The contract provided that "The maximum amount of ground water infiltration that will be allowed is 1200 gallons per day per mile of pipe. If more ground water infiltrates the sewer pipe than stated above as measured by the Engineer the Contractor shall immediately, upon receipt of notice from the Engineer that the infiltration is excessive, make the necessary repairs to reduce the infiltration to the allowable limits." It also provided that the contractor would be fully responsible for any defective work or materials, and provided for compliance with specifications as to materials and for strict conformity with plans except for authorized changes.

The subsequent mix-up was caused by the infiltration of not 1200, but 288,000 gallons of water per mile per day.

The Village had paid the Contractor $23,000 and owed about $5000 more when the suit was brought by the contractor. The Village cross-complained for $22,000 (the cost of re-laying the sewer line to prevent excessive infiltration of water) and for $25 per day liquidated damages for failure to complete the sewer.

During the trial, the contractor attributed the infiltration to the use of a cold mix joint compound, which had been listed as approved in the contract specifications. It proved unsuitable because of excessive pressure from ground water. The Village, on the other hand, contended that the compound was satisfactory, and that the contractor had chosen it in place of a hot mix compound, also specified. The Village also maintained that the infiltration was due to defective workmanship in the laying of the pipe and back-filling.

After much debate, the jury found that 25% of the infiltration was caused by defective workmanship and 75% by failure of the joint compound. (This just goes to show how smart our juries are.)

The Trial Court thereupon held that the Village was entitled to a reduction of $1600 on the contract price. This made both parties very unhappy, and they both appealed to the Supreme Court of Ohio. According to this distinguished Court, there was no *guaranty of performance* by the contractor, or of the "perfection of the plan", but merely of the materials and workmanship. It was simply his duty to follow the plans and specifications. The jury verdict and the judgment of the Trial Court were therefore upheld.

• • •

Street Cleaning in Raleigh

Raleigh, N. C., in the 1956-57 fiscal year swept 10,727 curb miles of streets, making 2,445 sweeper dumps. It flushed 12,305 miles of streets using 21.468 million gallons of water.

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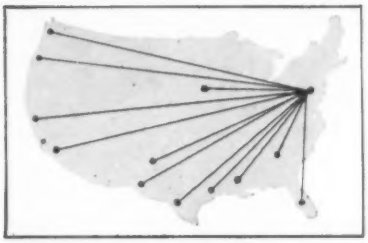
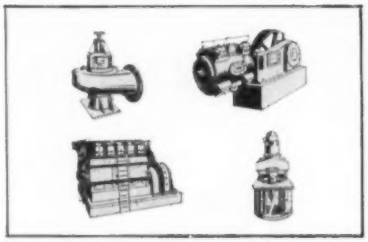


NATION-WIDE EXPERIENCE

Public Works representatives from Worthington criss-crossed the nation during 1957 bringing their knowledge to hundreds of municipalities. In so doing, they increased their skills by solving scores of local problems on equipment selection and application.



EXTENSIVE PRODUCT EXPERIENCE

Worthington makes a complete line of specialized equipment for water and sewage works. These are Worthington's basic products and the year they were introduced. Pumps (1840), Compressors (1893), Engines (1896), and Comminutors (1948).

REGIONAL REPRESENTATION

A network of Worthington Offices spans the nation, from New England to California, from Canada to Mexico. Staffed with experts trained in every phase of Public Works, these offices are your assurance of the best possible equipment and the finest possible application.

Key personnel in Worthington's Public Works Department have a combined experience in all phases of water and sewage plants of over 100 years.

Works experience is at your service

In Public Works there is no adequate substitute for experience. Worthington's experience in this essential field dates back to 1854 when the company's founder installed his first municipal water works pumps at Savannah, Georgia. Others soon followed. A duplex pump was installed at Charlestown, Massachusetts in 1863. Pumping engines were installed in Fort Worth, Texas in 1893. Twelve triple-expansion engines were put in at Philadelphia, Pennsylvania in 1908. Now the list is almost endless. There is hardly a municipality in the United States today that does not have a Worthington pump, compressor, engine or comminutor in service. This vast, cumulative experience and know-how proves invaluable year-in, year-out to communities in search of the very finest in service and equipment.

WORTHINGTON

HERE'S ASSURANCE

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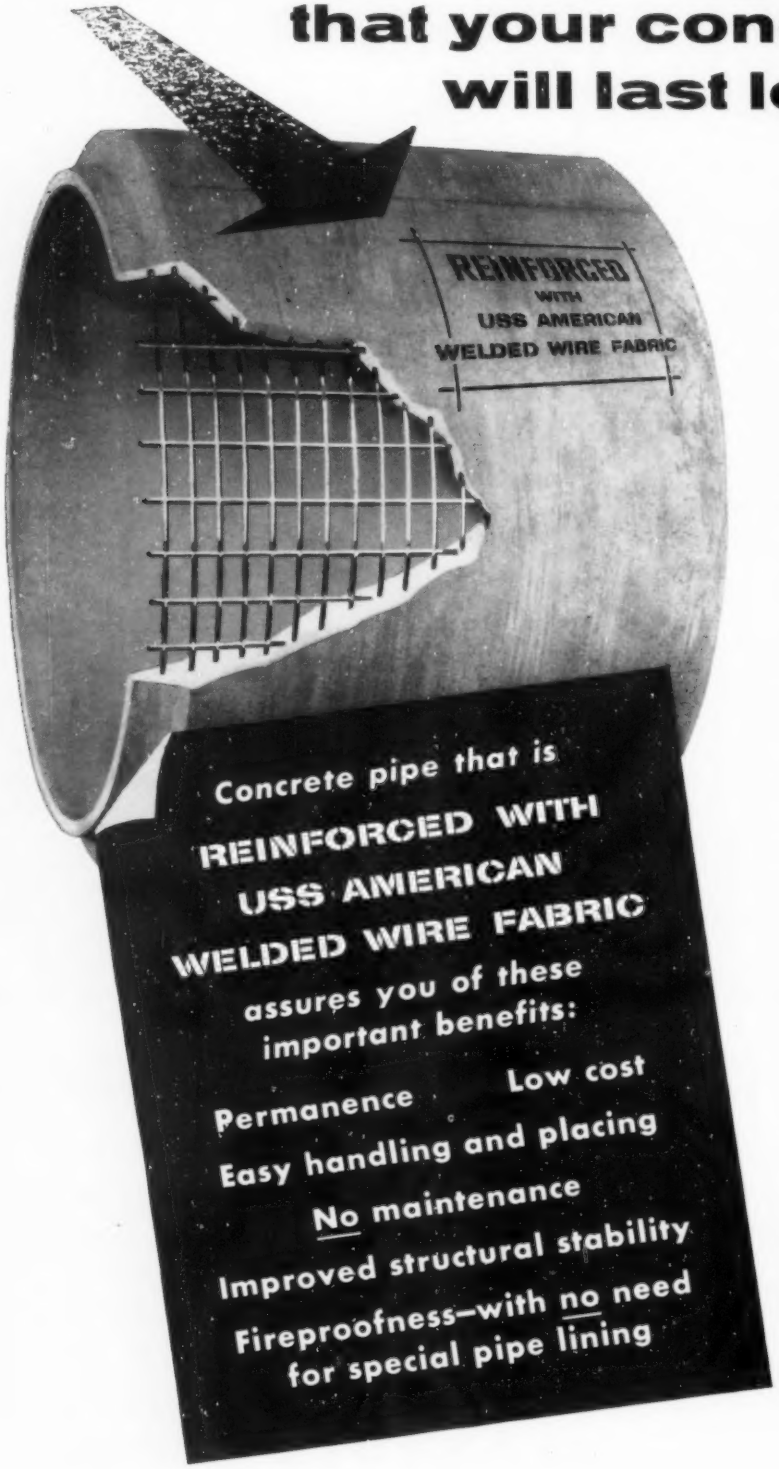

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Next thing you know, she'll complain!

It's time now for Dow calcium chloride

When woman meets dust—day after day, wipe after wipe—be prepared. Before she can register complaint, treat unpaved roads with clean Dow calcium chloride. Now is the time!

You can apply Dow calcium chloride dry or spray it in a water solution. The wet application provides almost immediate dust-laying relief upon contact with a road's surface. There's no odor, and one application lasts weeks.

An especially welcome advantage of Dow calcium chloride is its cleanliness. Both Dow forms—Peladow® and Dowflake®—are white-as-snow pellets or flakes that absorb moisture from the air to keep road dust in place. Non-oily, these products resist being tracked about on shoes or car tires. Little wonder, Dow calcium chloride ends dust complaints so well. No mess. No odor. And its stabilizing effect reduces gravel loss as much as 80%, blading costs as much as 85%!

For more information on Peladow or Dowflake, and for application assistance and recommendations, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. CC507B.

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WHY YOU GET MORE FOR YOUR TAX DOLLARS with a Caterpillar Motor Grader!

Engaged in street work in Phoenix, Arizona, this Cat No. 112 Motor Grader delivers economical, efficient performance. It is on the job 8 hours a day, 5 days a week, all year around.

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- **"Never let us down!"**
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- **"Economical in the long run!"**

These statements about Cat Motor Graders were made by public officials from different sections of the country. They hold real significance for every one responsible for the purchase of equipment, because they highlight the importance of figuring *total cost* when buying a machine. Total cost, or last cost, covers what you pay for a machine . . . how much work it does for you . . . what you spend on it for operation and maintenance . . . how much it can bring you when you trade it in. Public records prove that on *low total cost* Caterpillar Motor Graders are the best investment in the field!

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1. **Mechanical controls** that are fast, dependable and accurate—with the new Preco Automatic Blade Control available on either model.
2. **A Caterpillar Diesel Engine** that burns low-cost fuels without fouling—and a fuel system that requires no adjustment.
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Before you invest in your next motor grader, check Caterpillar performance with officials in neighboring communities. For complete facts, including total-cost data on municipal road building and maintenance, see your nearby Caterpillar Dealer. Better still, ask for a demonstration—say when and where, he'll be there!

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

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BUY LOW TOTAL COST—
BUY CAT MOTOR GRADERS

LIQUID CHEMICALS for Dust and Ice Control

HENRIK E. STAFSETH,
Engineer-Manager,
Ottawa County,
Grand Haven, Michigan

THE FIRST seven months of operation using liquid calcium chloride as a chemical treatment for dust and ice control has been completed by the Ottawa County Road Commission. Some limitations, however, have been found to its use for ice control.

The Road Commission services 1,050 miles of local or township roads, 360 miles of county primary roads and 169 miles of state trunklines. Ottawa County is located on the east shores of Lake Michigan directly east of Milwaukee.

Two years ago, the Commission commenced a study to determine the advisability of using liquid calcium chloride or salt brine as a substitute for flake calcium chloride, in order to reduce cost in the completed applications of these chemicals for dust and ice control. This was not an original idea with our county. The first county to use any considerable amounts of this material in Michigan was Washtenaw County, and they have been using it for many years. Our neighboring county directly east of us, Kent County had also been using some of the liquid materials for dust and ice control. We would like, at this time, to acknowledge the helpful suggestions that were contributed by these two county organizations to the success of our program and to the writing of this article.

Preliminary Study

The first problem studied was to determine the type and source of material to be used. We made a comparison of the local salt brines produced from oil wells within our county and the commercially produced liquid calcium chloride with plants located approximately 70 miles from us. The various brines were tested by a commercial laboratory to determine the percentage of chemicals present in these brines, as well as in the commercial liquid calcium chloride.

Analyses of brines from wells in Ottawa, Montcalm and Gratiot Counties showed them to be generally similar. Specific gravity ranged from 1.195 to 1.224, compared to 1.387 for the commercial product. Calcium chloride content was 6.0 to 10.9 percent, compared to 37 percent for the commercial calcium chloride; weight per gallon for the well product was about 10, compared to 11.565; magnesium chloride varied from 2.9 to 3.8 percent in the brines, but was 1 percent in the commercial; sodium chloride percent in the brines was 12.3 to 15.6, but in the commercial grade it was 2 percent.

● **TYPICAL liquid chloride distributor treating a gravel surfaced road. Tank should be plastic lined to minimize corrosion. Capacity of the unit shown here is 1250 gals.**

We decided to use the commercial liquid calcium chloride for the following reasons: (1) The high concentration of calcium and magnesium chlorides as against the low concentration of sodium chlorides; (2) to get the equivalent amount of calcium and magnesium chloride in the local brines would require handling four times the amount of local brine; (3) the quantities of local

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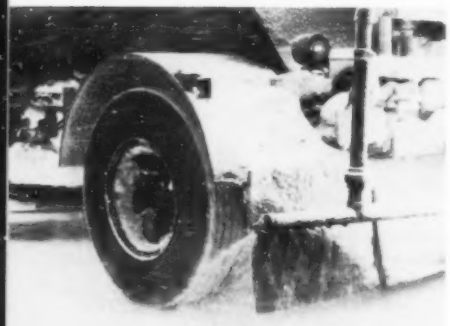
brine that could be produced was questionable. It was estimated that in our operation we would use approximately a million gallons of the commercial material per year; (4) the commercial product can be used successfully at temperatures above 10°F, while the local brine is limited to approximately 20°F above 0. During the use of these materials for ice control, a large percentage of the time the temperature of the atmosphere would probably lie between 10 and 20°F above 0.

The final consideration as to the type of material to be used was based on the following cost analysis, which considered the cost for applying one pound of calcium chloride. All types of materials were reduced to this same standard.

The analysis showed it would cost 0.72 cent per pound of calcium chloride to apply local brines, plus the cost of the brine. For flake calcium chloride, the cost per pound would be 1.75 cents and for application 0.23 cent, a total of 1.98 cents. For bulk calcium chloride corresponding figures would be 1.46 cents and 0.19 cent, a total of 1.65 cents; and for 38 percent liquid calcium chloride 1.03 cents and 0.18 cent, a total of 1.21 cents.

It can be seen that if the local brine could be produced for less than half a cent a gallon, it would be cheaper than the commercial material. If the local brine were used, there was concern for the large amount of sodium chloride that would be deposited upon our gravel roads.



● **LIQUID chloride is effective also in snow removal and ice control work.**

Type of Equipment

The type of distributor decided upon for the application of the liquid calcium chloride was a 1250-gallon tank on a 29,000 pound GVW truck, which was already equipped with an underbody scraper. The rear axle on this unit, fully loaded with the liquid calcium chloride, would not exceed Michigan's 18,000-pound weight limit for a single-axle truck. The larger or semi-truck distributor was considered, but we learned from other counties that had used the large trucks that the total weight of the large trucks loaded, exceeded the practical loading limits for local roads and bridges. The truck with a distributor and an underbody scraper attachment is a very compatible unit for summer maintenance of the gravel county roads and for winter maintenance of the hard surfaced county roads and state trunklines.

The distributor tank for carrying this material should be plastic lined to minimize corrosion. This plastic lining is sensitive to heat so that mixing of flake calcium chloride with water in these tanks to make the liquid chloride is not advisable.

The power unit to distribute the liquid chloride from the tank should be located at the front end of the tank as far from the distributor bar as possible. We learned that the liquid chloride, when being distributed under pressure, forms a fog that is both corrosive and a strong electrolyte, causing a great deal of starting trouble to the gasoline engines located on the back of these distributors.

This problem of starting our gasoline engines is the only difficulty we have encountered. At present, we have one truck, that we are experimenting with, that has a power take-off from the transmission which drives the distributor pump. We have used this for only a very short period; however, it looks as though it will be the answer to our problem. The approximate cost of a distributor tank mounted on the underbody scraper truck is $2,500.

The storage tanks that were erected are a type of tank used in the petroleum industry for storing the crude oil at the wells. These tanks are prefabricated and can be erected in a day. We took bids on these tanks, erected, with a bituminous coating applied on the inside surface to protect against corrosion. The fittings on the tank were very simple: a 2-in. pipe and valve at the bottom to draw off the material and a 2-in. pipe running to the top of the tank for putting the material in storage. No pumps were provided at the storage sites. The Road Commission took bids for the liquid calcium chloride fob in their storage tanks. When the material is being loaded into the distributors, the pump on the distributor is used. The cost of these tanks erected in our yard complete was $1850 for a 500-barrel and $2500 for a 750-barrel.

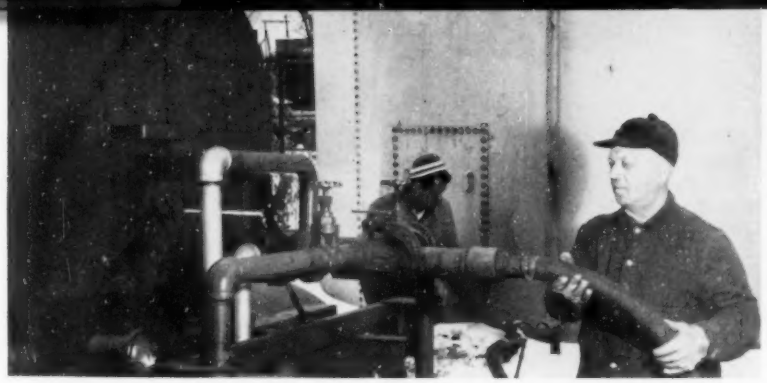
Rate of Application

For dust control, two types of application were used on our county roads. One was a spot treatment, five hundred feet in length and 12 feet wide, in front of each house. The average amount of chloride of the 38 percent material was 120 gallons per application. The other type of treatment was a continuous application, which was also 12 feet wide and which required an average of 1200 gallons per mile. The above rates of applications are equivalent to one pound of flake calcium chloride per square yard.

Actually, the 12-foot width treatment does not cover the full width of our county local gravel roads. This width was suggested by the Kent County Road Commission as a practical working width on a local county road in the rural areas, that had approximately fifty cars per day traffic. The theory is that, in most cases, the traffic will use the center of the road, and this eliminates the necessity of applying the liquid chloride the full eighteen or twenty-foot width of the gravel surface. This proved to be a very helpful suggestion, because by eliminating one-third width of the treatment, it eliminated one-third of the expense of the program and put it within the paying capacity of the county and townships. On gravel roads that have large traffic volumes, the liquid calcium chloride was applied the full width.

The policy of our Road Commission was that the county and townships pay for the two applications of this material on the county road. If anyone wanted an additional treatment, which in some cases was needed, we made a charge of $10 per spot treatment to these individuals.

The 1957 summer, the only season that we have had to draw any conclusions from, was an average summer and was not particularly dry or wet. On the local county roads, the two applications proved to be adequate. Also, I would like to point out that by applying the liquid chloride, the Road Commission realized a substantial savings by the preservation of the binder material in the gravel. The gravel maintained a smoother surface for a longer period of time after the liquid chloride treatment, thus reducing the amount of scraping required. It was noted that the liquid, when ap-



● **LOADING liquid chloride into distributor. In distribution, chloride fog interferes with gasoline engine starting. Therefore, power take-off is used instead of engine.**

plied, stayed in place and would not mechanically be thrown out of the gravel by a passing car during a dry period, which sometimes happens to flake materials. We felt that our dust program proved to be very successful by using the liquid material.

Ice Control

For ice control, 20 to 23 percent calcium and magnesium chloride is used with 5 to 6 percent of sodium chloride. This material is used because the 38 percent materials would solidify at freezing temperatures and could not be handled. The cost of 38 percent calcium chloride fob at our Ottawa County storage tanks was $45 per thousand gallons and the cost of 20 to 23 percent liquid calcium chloride was $27 per thousand gallons.

Our experience on ice control is confined to approximately one month, but the results that we have obtained seem to substantiate the results that Washtenaw and Kent Counties in Michigan are experiencing. One of the big advantages of using the liquid as against other types of material is the fact that it is a one-man operation. The material can be loaded and distributed quickly.

On roads that are covered with packed snow that is from ½-in. to 1-in. thick, a load of 1200 gallons will cover approximately seven miles, or the application rate is around 175 gallons per mile. A thin sheet of ice or sleet will require approximately 100 gallons per mile. The truck, while applying this liquid material, can travel at a rate of thirty or thirty-five miles an hour provided, of course, it can maintain its own footing.

We have used this material at temperatures down to 10°F above 0°, and we may be able to use it slightly lower. This material should not be used in a heavy snow storm for it will be covered before it can act. Caution should be used during periods of high wind velocity. It is difficult to describe these limiting factors; but through trial and error, an effective operation can be worked out. A big advantage for this type of material or a pure chemical treatment, is that storm sewers do not become clogged by sand and grit.

When applying liquid chloride for packed snow and ice control we use the left half of our distributor bar. On two-lane highways, the distributor hugs the centerline and sprays liquid calcium chloride on both sides of the centerline. In a matter of five to ten minutes, the liquid material cuts through the packed snow or ice making an ice and snow free strip two or three feet on each side of the centerline. This affords the motorist a good surface for his two left wheels.

Conclusion

The use of a commercial liquid calcium chloride has proved to be very successful for dust control and has good possibilities for ice control within certain limits. It has eliminated a great deal of handling that was required for the same chemicals when furnished in the dry state. The Ottawa County Road Commission is one of the fortunate counties in the country that is within a reasonable hauling distance to make the delivery of liquid material practical from a cost standpoint.

The estimated cost of applying liquid material on the dust control system proved to be the actual cost. The sum result of our operation was that we could buy and distribute the liquid chloride for a half a cent less than we could purchase the bagged flake calcium chloride and a quarter cent less than the bulk calcium chloride on a per pound of material basis.

WASTE TREATMENT PLANT SERVES HIGHWAY RESTAURANT

LOCATED in northern New Jersey, near the New York-New Jersey line, some 20 or 25 miles out of New York City, the Swiss Chalet restaurant has a seating capacity of 650 and a staff of 32. The maximum patronage is estimated at 1500 per day, served by 35 employees. As with all such installations located beyond the sewer lines, treatment facilities had to be provided for the liquid wastes. Albert Crew, consulting engineer of Ridgewood, N. J., was retained to design facilities to replace an inadequate septic tank installation.

The quarterly water consumption records for the preceding two years showed a peak demand of 805,000 gallons in the September, 1955, quarter. The design of the plant was based on an average contribution of 8 gallons per patron per day, 12-hour operation, and 50 gallons per employee per day. With the probable maximum flow estimated at 13,750 gpd, design was based on 14,000 gallons in 12 hours, or 19½ gpm. The future maximum raw sewage BOD was assumed at 400 ppm and the plant was designed to produce an effluent of less than 40 ppm over any 4-hour period and generally about half this. After chlorination, the effluent is discharged into an adjacent water course.

The existing installation, inadequate to treat the wastes from the restaurant, was reinforced during the plant construction period by a subsurface sand filter 4 ft. wide, 50 ft. long and 12 ins. media depth. Upon completion of the other treatment units, this sand filter was abandoned. To reduce the load on the sand filter pending operation of the new plant, the settling units of the new plant were constructed first

and put into service. Previously sedimentation was accomplished in a 2000-gal. septic tank which was continued in operation, after completion of the new plant, as a grease interceptor.

The plant consists of an Imhoff tank, pumps, a high rate trickling filter and a final settling tank, with chlorination of the effluent, and with recirculation facilities from the outlet of the filter to the recirculating sump.

The Imhoff Tank

The Imhoff tank is built of reinforced concrete pipe sections, 10 ft. in diameter, set in place on a bottom slab of reinforced concrete 12 ins. thick. Provision is made to remove the digested sludge through a 3-in. pipe by pumping and removal to discharge areas provided in the general vicinity for disposal of residential septic tank sludge. The settling compartment is of 3/16-in. steel, 9 ft. in diameter. This provides an annular gas vent 6 ins. wide at the surface, a settling compartment with vertical sides 4 ft. deep, and a sloping hopper, 1 on 1.4, approximately 63½ ins. deep. A 12-in. slot and 6-in. overlap are provided. Based on a flow of 14,000 gallons in 12 hours, or 1160 gph, the detention time is 2.51 hrs. and the surface settling rate is 440 gals. per sq. ft. per day. A sludge storage depth of 5.1 ft. is provided, 10 ins. below the overlap, with a sludge storage capacity of 429 cu. ft., or 3.06 cu. ft. per 100 gallons of estimated maximum daily flow.

Three lengths of concrete pipe were used for the tank. A key was provided in the bottom slab and this was filled with mortar after the pipe was placed. A concrete topping was also provided. Effective depth of the tank is 16.9 ft. and total depth, top of wall to bottom of floor slab, is 20.75 ft.

The Trickling Filter

Based on a raw sewage strength of 400 ppm, reduced to 260 ppm in the Imhoff tank; and a filter loading of 1.8 pounds of applied BOD per cu. yd., the expected effluent strength would be 26 ppm BOD with a recirculation of 2½ times the flow. This would require a filter volume of 30.2 cu. yds.; however, with a diameter of 16.5 ft. and a depth of 6 ft., 47.6 cu. yds. were provided. This resulted in a maximum hydraulic loading of 20 mgad and a minimum loading of 14 mgad.

The effluent from the filter flows to a V-notch weir box set to return to the pumps 2½ times the raw sewage flow, or 49 gpm. There are two pumps which pick up the effluent from the primary tank and the recirculated flow and feed this to the filter. These are duplicate, submerged type centrifugals of 75 gpm capacity, operating alternately, but with controls to permit dual operation. Space is provided for a sludge transfer pump to handle secondary sludge to the primary tank, if needed in the future.

The filter is provided with a Carter distributor, and has underdrain blocks and an offset channel with cover blocks and vitrified clay vent blocks and risers. The floor is sloped 3 inches to the center channel, which in turn discharges directly into an effluent distribution box.

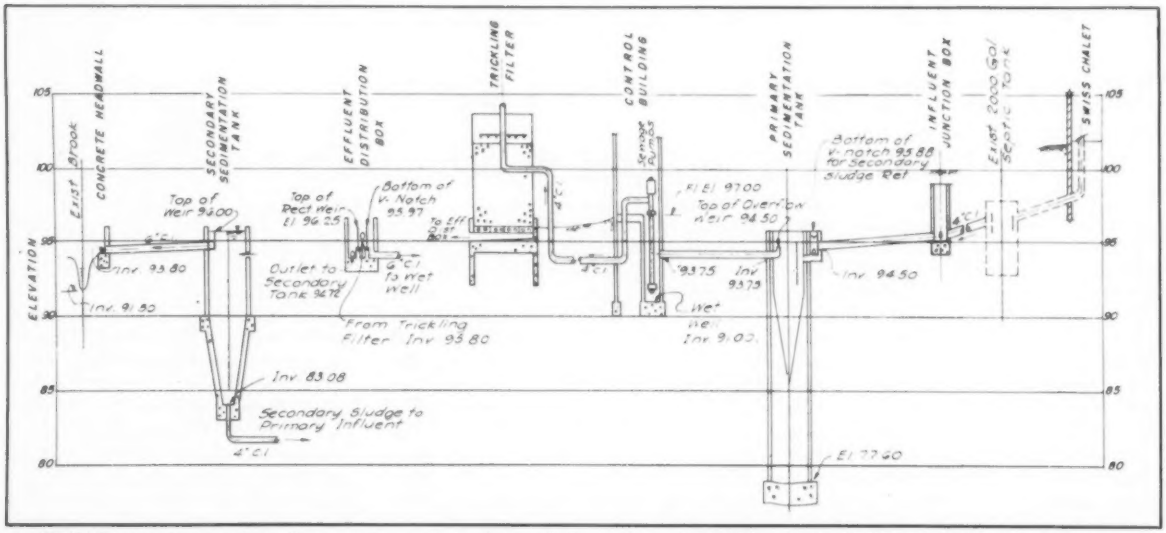
An electrically operated Wallace and Tiernan automatically controlled hypochlorinator is provided in the control building. This feeds to the effluent of the trickling filter prior to entrance to the secondary settling tank; the hypochlorinator stops when no sewage is flowing to the secondary. Capacity is sufficient to apply chlorine at a rate in excess of 15 ppm to the effluent.

Secondary Sedimentation

The secondary settling tank is built of a section of 10-ft. diameter reinforced concrete pipe placed on an inverted concrete cone, which acts as a hopper bottom. The vertically walled settling section is 5.7 ft. deep; the hopper, with side slopes of 1:1.7, is 7.22 ft. deep. This tank provides a detention period of 4.4 hours for the design flow and a surface settling rate of 357 gals. per sq. ft. per day. The sludge from this tank is returned automatically by gravity to the primary tank, but piping is provided so that a sludge pump can be installed in the control building to insure positive removal.

Provision is made for lighting the treatment plant area. Both primary and secondary tank openings are protected with Kerrigan galvanized grating. Steel plates are used to contain the filter stone. These are ¼-in., painted with one shop and two field coats. Angle stiffeners were provided as required.

The cost of the installation was slightly in excess of $30,000, including the temporary facility necessary to handle the wastes during the period of construction.



● **SEWAGE treatment plant for a restaurant is designed for a flow of 14,000 gals. in 12 hours, utilizing Imhoff type primary settling tank and high rate trickling filter with recirculation. Raw sewage BOD is 400 mg/L; filter loading is 1.8 lbs/af.**

New Reservoir

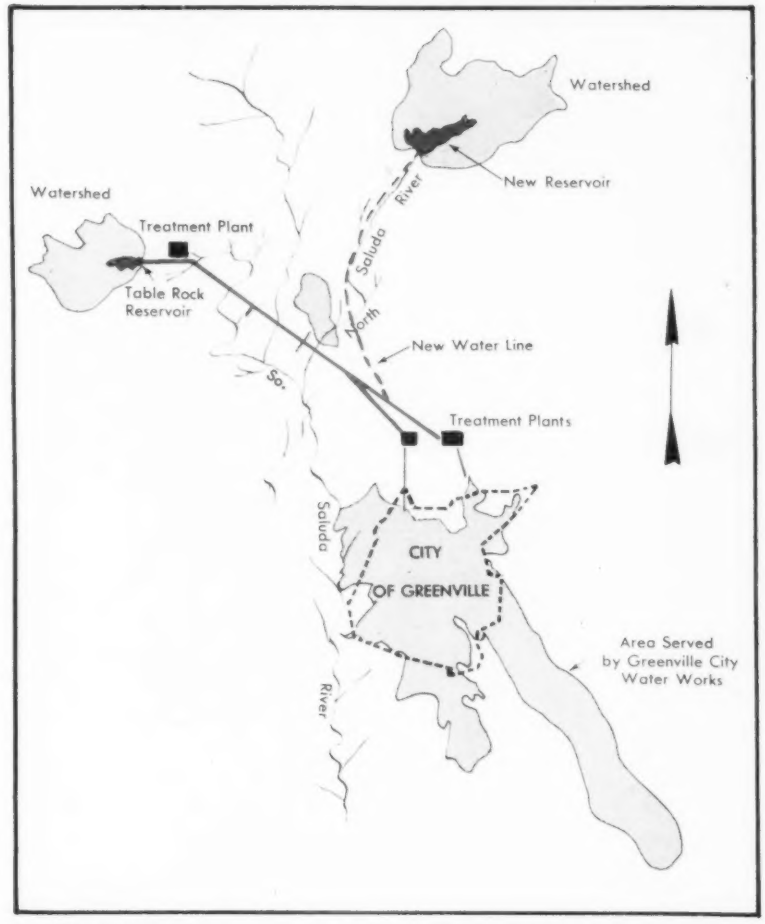
will yield 41 MGD

THE PROBLEM that is becoming common across the country—rapidly growing cities that are just as rapidly outgrowing their water supplies—has been met by Greenville, S. C. When that city built its 9½-billion gallon Table Rock Reservoir in 1926, it believed it was well fixed for water for the distant future. But the 25-million gallon daily consumption on hot summer days by the 165,000 residents exceeds the average yield which is 19 mgd in years of extreme drought and 35 mgd in years of average rainfall. Present average daily consumption is about 17 mgd.

To solve this problem before it becomes disastrous, the Greenville Water Works has embarked on a $9 million program to develop a new reservoir with an average daily yield of 41 million gallons. The City issued revenue bonds to finance the North Saluda Reservoir project, which includes clearing 1100 acres of mountain land; construction of the main dam, an off channel spillway and a partial treatment plant; laying 15 miles of 48-inch water transmission line; and relocation of three miles of US Highway 25. Part of the cost of the highway relocation is being paid by the state.

First the Water Department, under the direction of John Hawkins, superintendent, purchased 30 square miles of land in the North Saluda River Basin, starting 25 miles north of Greenville and running to the state line. Of the 800 properties acquired, less than 20 had to be condemned and only one had to go to court for a decision. More than 500 families were moved; more than 300 buildings moved and sold. Greenville spent $2,900,000 for these properties, including churches, homes, a clubhouse, an 18-hole golf course, two motels and a portion of the North Carolina Elks Club, which extended across the state line.

All of the timber in the basin was sold to the Piedmont Forest Products Co., of Whitmire, S. C. The area yielded about one million board feet of saw timber at $16 per thousand feet, and a thousand cords of pulpwood at $3.50 per cord.



● **LOCATION MAP shows new reservoir now under construction in the North Saluda Basin, existing Table Rock Reservoir, pipe lines, treatment plants and areas served.**

Cherokee, Inc., of Columbia, S.C., took the $2,800,000 contract to build the dam, spillway and structures. Starting May 1, 1957, Cherokee has 600 days to complete the project. Other contracts are yet to be let for the treatment plant and pipe laying. Water from the new supply is expected to be turned into city mains in 1960.

The main dam will be 1600 feet long at the top, 1400 feet wide at the base, and rise 167 feet above stream bed. The core trench was cut an average of 50 feet deep to hit solid rock. The impervious core and upstream two-thirds of the 2,700,000-yard dam is being built up with red sandy clay, compacted to 98 percent Proctor. The pervious downstream third will be of disintegrated rock. Upstream slopes will vary from 3 to 1 at the toe to 3-1/2 to 1 at the top. Downstream slopes will be 3 to 1, with 10-foot berms every 30 feet in elevation.

Photos courtesy Caterpillar Tractor Co.

● **DAM FOR North Saluda reservoir under construction. Completed dam will contain 2,700,000 cu. yds. Fill is dumped in 6-inch lifts, spread and then compacted.**

Stripping and coring was accomplished with Cherokee's 16 Caterpillar DW21-470 tractor-scrapers, pushloaded by Caterpillar D9 and D8 tractors. Adequate supplies of red sandy clay are available within the reservoir area, but deposits are small and hauls from the 15 borrow pits are as much as two miles long. Three Caterpillar 12 motor graders maintain the haul roads to help speed the DW21s.

Fill is spread on the dam by the DW21s in six-inch lifts. Two D8s, pulling sheepsfoot rollers, further spread and compact the fill. Also on compaction is a 50-ton Tampo pneumatic roller, pulled by a Euclid tractor.

Large quantities of disintegrated rock—residual granite— are available nearby. Caterpillar D318-powered Koehring 304 and Bucyrus-Erie 38D draglines are assigned to excavation tasks. Rock is hauled in two rear dump and ten rock wagon Euclids. Short-haul excavation and cleanup work are handled by Caterpillar No. 80 and LeTourneau LP scrapers, pulled by D8s. Other equipment includes two Caterpillar D6 tractors, an Allis Chalmers HD20 and HD21, an International Harvester TD14A loader, two water trucks, four I-H, AC and Euclid scrapers, and two Galion graders.

During construction of the dam, the North Saluda River is being diverted through a 72-inch concrete outlet pipe encased in a square reinforced concrete casing. When the dam is put in operation, this pipe will serve to help control the level of water in the reservoir, and provide a source of additional flow from the reservoir when needed. A 48-inch concrete pipe through the dam will carry water by gravity to the treatment plant and on to the city mains. All concrete work has been subcontracted to Terry Construction Co., Greenville.

Major flow of the North Saluda River will be over a concrete spillway located one mile southwest of the dam. To make way for the spillway, rock is being drilled by a Thor wagon drill powered by a Worthington air compressor. Three-inch holes are drilled to grade and loaded with DuPont 25 percent dynamite.

To keep the equipment rolling, Cherokee services all rubber-tired equipment every night. Crawler tractors are serviced during the day. Assisting Grady Jordan, general superintendent, are Jim Walker, grade foreman; George Pettus, fill foreman; T. R. Weed, drill foreman; and Ralph Hutto, master mechanic.

To supplement the above information, Mr. Hawkins sends us the following: The treatment of this water is fairly simple. To begin with Nature smiled on Greenville by placing within a reasonable distance the finest water to be had anywhere. Our treatment is fully automatic. We apply ammonia and chlorine for bacteriological control and soda ash for pH control. There is a treatment plant immediately below the Table Rock Reservoir and there will be another right below the dam at North Saluda. The treatment at both places will be almost identical.

The water from these two impounding reservoirs will feed through two 30-inch mains from Table Rock and one 48-inch main from North Saluda into two intermediate reservoirs which float on the distribution system. Both supplies will be by gravity. We do, however, have a booster station on the two 30-inch lines from Table Rock that is operated during periods of peak demands. Most people do things the hard way but we do it the easy way. We pump water down hill. That booster station operates at least a few hours a day from sometime in May until sometime in October.

The yield of our Table Rock supply in years of extreme drought is 19 mgd year-round daily average. The yield of the North Saluda supply will be 41 mgd year-round-daily average in years of extreme drought. After the development of North Saluda is completed we will be prepared to meet peak daily demands of $83\frac{1}{2}$ mgd.

The present expansion program is being carried on by the sale of water revenue bonds. The original estimate of the cost of the North Saluda project was $9,000,000 but in spite of this large expenditure and the large service area of the department our rates are still most reasonable and very few cities can boast of lower water rates than ours.

Don McDuff is project engineer for Black and Veatch, Consulting Engineers, of Kansas City, designers of the reservoir. Commissioners of the Greenville Water Works are H. C. Beattie, chairman; J. E. Hart, J. K. Cass and Gus Smith.

● **TO GET the impervious material required for the core of the dam, it was necessary to utilize some 15 borrow pits in the area. Here tractor-scraper is taking a load.**

A STUDY OF SEWERAGE for METROPOLITAN DENVER

O. JOHN SCHMIDT, Black & Veatch, Consulting Engineers

POPULATION increases stem from two sources, live births exceeding deaths and immigration. Both sources have been important in the unusual growth being experienced in most western states. The population growth in these states, particularly in the past several years, has been unparalleled, exceeding estimates of even the most optimistic forecasters. Although some of the western states have increased more in total population, few have outstripped Colorado's rate of gain.

Between 1950 and 1956 Colorado's population increased by 297,500, a gain of 22.5 percent. The national average population gain in this interval was 10.9 percent, with only six states exceeding Colorado. Greatest growth in this period occurred in the Denver region where the population increased by 156,150 or 27.5 percent. Moreover, the steady stream of migrants settling in the Denver area has shown no signs of diminishing. In fact most agencies concerned with estimates of future population agree that the present accelerated growth rate of Metropolitan Denver probably will continue for a number of years in the future. The Inter-County Regional Planning Commission in Denver has forecast a population of 1.5 million for Metropolitan Denver by 1980.

Sewerage Facilities

Between 1950 and 1956 the Metropolitan Denver population served by sewage treatment works increased from 440,000 to more than 700,000. There are now 32 sewage treatment works in the area, including State and Federal government plants, together with municipal, sanitation district and subdivision installations.

These include six primary plants serving a population of 712,000, including industrial wastes with a population equivalent of over 125,000; six intermediate treatment plants, serving 122,590 population, about 2/3 of which is industrial waste; 11 complete plants serving 100,375 population; four oxidation ponds serving 4,350; and five community septic tank installations serving 2,550 population. Based on hydraulic and organic loadings and State Department of Health Standards, nine of the plants—seven of the complete treatment installations and two of the oxidation ponds—are adequate; nine are inadequate—four of the primary plants, two of the intermediate and three of the septic tanks; nine are overloaded—two primary, four intermediate and three complete; and one complete treatment plant is under construction.

Thus only nine of the 32 units are now adequate. Actually several of the nine adequate plants are now loaded nearly to capacity, and with the increased future sewage flows expected, overloading is imminent. It can be seen that in spite of an effort to provide sewage treatment facilities within the Denver region, population growth has been so rapid that most of these facilities have become inadequate, some after only a few years of operation.

Metropolitan Denver contains forty-five sanitary authorities responsible for sewage collections as well as treatment. These authorities, which differ greatly in structure, include incorporated communities, sanitation districts, subdivisions, military installations, State and Federal agencies, and other groups. The vast number of separate organizations required to administer these sanitary authorities has made coordinated planning among them very difficult. A good example of the sewage problems now confronting sanitary authorities in the area is found in the Clear Creek watershed.

Fourteen municipalities, sanitation districts and subdivisions lie quite close to each other in the Clear Creek drainage basin which joins the South Platte River north of Denver. Nine of the ten existing sewage treatment works are unsatisfactory because they are overloaded or because they do not provide a high enough degree of treatment. These treatment works are located very close together; two are about 300 feet apart and three others are on a one mile stretch of the Creek. In three of these plants large volumes of strong industrial wastes have caused serious overloading of the treatment units.

Denver and Service Areas

Denver presently is served by two primary sewage treatment plants, the North Side Treatment Plant with a capacity of 85 mgd which now serves 552,600 persons, and the East Side Treatment Plant with a capacity of 4.5 mgd which serves 25,000 persons. To meet the Sewage and Trade Wastes Effluent Regulations, addition of secondary treatment works is considered necessary. The cost of these additional treatment units for the North Side Plant is estimated to be 8.5 million dollars. Enlargement of this plant to provide complete treatment for an average flow of 110 mgd would be possible and highly desirable from a regional viewpoint. This enlargement has been proposed as part of a Basic Sewerage Plan for Metropolitan Denver and would cost an estimated 3.5 million dollars in addition to the 8.5 million dollars required above.

Over 40,000 persons in Area No. 4 west of Denver, the area tributary to the South Platte through Denver, are now served by the Denver sewer system. This area in Jefferson County includes twenty sanitation districts, several incorporated communities, the Federal Center, and other areas. More than 1,700 persons in Arapahoe County south and east of Denver, and 2,300 persons on the Berkeley Main in Adams County

• *From a 1957 study of Metropolitan Denver by Black & Veatch*

are also connected to the Denver sewer system. There are, in the areas outside of Denver, but served by it, six incorporated communities of 7,795 population; 15 sanitation districts of 28,542 population; two unincorporated areas, one Federal center and other sections with an additional 8,152 persons. Population of these areas totaled 44,489 in 1956.

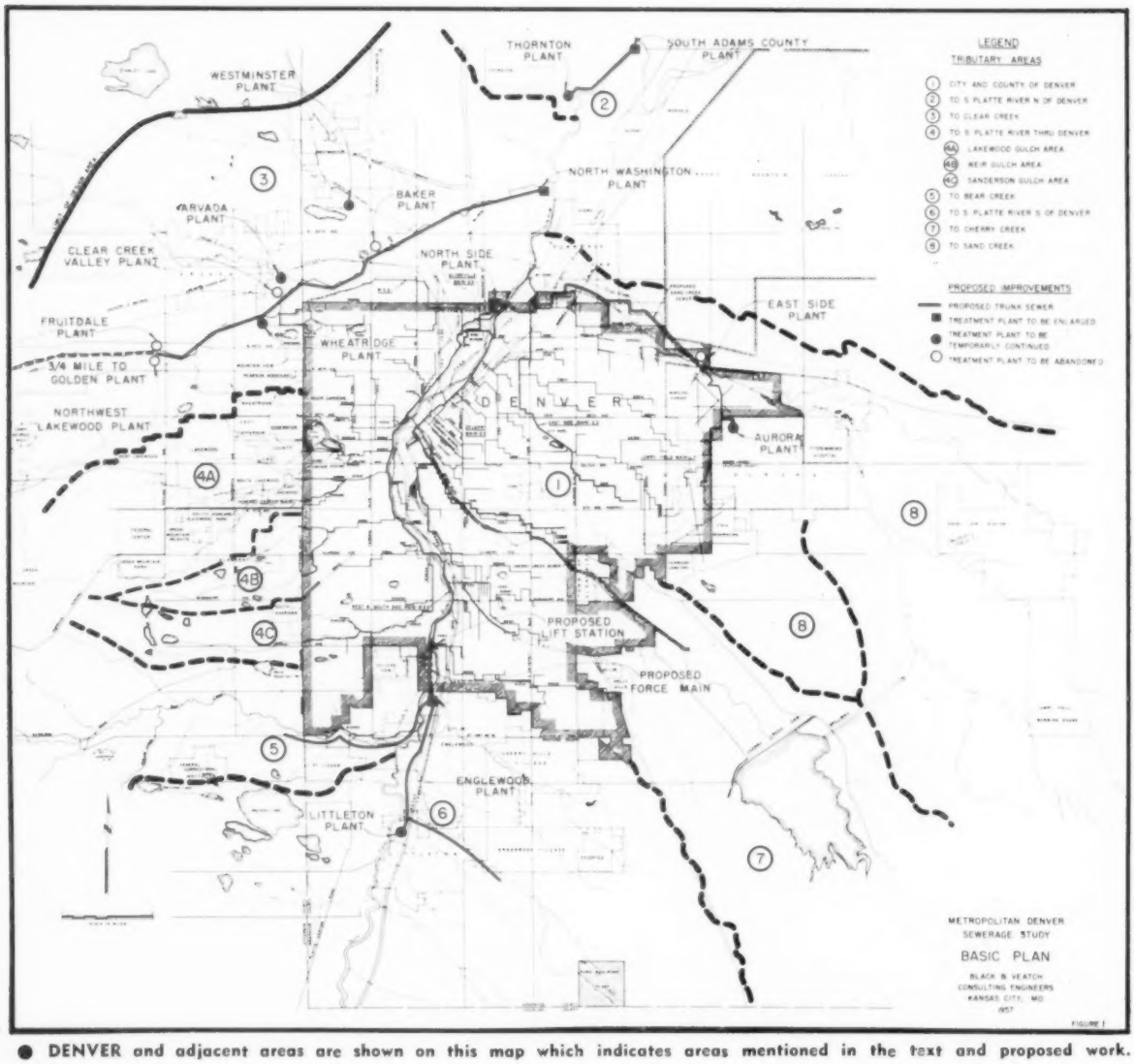
Transfer of ultimate sewage flow from tributary areas in Jefferson County is limited by the capacities of the Denver west side laterals and the West and South Side Main. Lateral and main relief sewers for the area have been studied but construction of a relief trunk sewer along the West and South Side Main would be very costly. A more economical plan would divert sewage flows from South Denver by means of a proposed lift station and force main, to a proposed Denver South Side Treatment Plant located on the South Platte River opposite the Englewood Plant. This diversion would reduce flows in the Denver West and South Side Main and would provide sufficient capacity in this main to carry tributary Denver sewage plus ultimate flows from the west outside area. Diversion of this flow to an enlarged Englewood Plant would accomplish the same result and has been recommended in the Basic Plan as a more economical solution to this problem.

The Basic Plan proposes abandoning the existing Denver East Side Treatment Plant. A proposed trunk sewer would carry wastes now handled by this plant to the Denver North Side Treatment Plant. The trunk would have capacity to convey the wastes from the ultimate population of a large portion of the Sand Creek watershed. It is estimated to cost $739,000.

Stream Flows and Water Use

In areas such as eastern Colorado where rainfall is sparse and water for both industrial and domestic use is limited in quantity, surface streams are used over and over again for both drinking water supplies and for waste disposal. Sometimes both of these uses are found close together on the same stream with the water supply intake receiving substantial amounts of treated sewage. With continued population growth there will be increased demands for water and the number of such "dual use" instances can be expected to increase. Under such conditions the need for a high de-

(*Continued on page* 181)



● **DENVER and adjacent areas are shown on this map which indicates areas mentioned in the text and proposed work.**

SOMETHING HAD TO BE DONE ABOUT STREET LIGHTING

HOMER HATHAWAY

IN THE summer of 1956, the Chamber of Commerce and the Retail Trade Bureau of Everett, Wash., decided that something had to be done about the street lighting in the business district of the city. The existing system was antiquated and definitely ineffective; most of the store fronts gave off more illumination than the lighting system.

First step in securing the change to a modern lighting system was a letter sent out to the businesses which would be affected. This sounded them out on the desire and the ability to finance such a project. The returns were exceedingly favorable, so the City Engineer, Rod Colvin, was approached to take the necessary steps to set up a local improvement district and to get action started by the City Council in the form of a resolution setting up such a district.

A hearing was held on such a formation on April 5, 1957 and the ordinance to make it official was passed the following month. There was less than a three percent objection from property owners, and a bid call was issued on June 4. Construction of the project was begun on June 17, and it was completed in October, 1957.

The city engineer's estimate on the job, which covered only a part of the entire business district, was $98,251. The low bid by Belden Electric of Everett was $85,440, so that the business men who financed the project actually received all the benefits for about $13,000 less than they had originally agreed to pay.

Parts of the project were installed on existing standards and conduit, the conduit already being beneath the concrete sidewalks. This, of course, necessitated the cutting of the sidewalks and the replacing of the cement after the standards had been installed. The contractor saved both time and expense in this operation by doing all of the cutting first, and replacing cement as he completed each installation. All installations were made without any interruption to the normal flow of traffic. This was accomplished mainly by working early in the morning before the town's business houses were opened. Even when it was necessary to block off traffic, only one or two parking spaces were blocked off at a time.

Courtesy Pfaff & Kendall

● **STANDARDS are of aluminum, 30 feet high, with brackets. Lights are mercury vapor Westinghouse with OV-20 globe. Standards were placed 66 to 80 feet apart.**

Where existing conduit was used, the standards were spaced about 66 feet apart, using between 8 and 10 standards in each block. They were furnished by Pfaff and Kendall, and were 30 ft. high aluminum standards and brackets. Lights were mercury vapor Westinghouse Luminaire with an OV-20 globe.

On the newer installations, where no conduits or base existed, the standards were spaced at a staggered distance of 80 feet apart, with about 6 standards to a block.

The actual cost of the project, proportioned among the owners of the property concerned, ranged from $125 to $2000 per 25-ft. lot. This was financed in such a way that the owners pay off their share of the financing over a 10-year period, just the same as a residential local improvement district would do.

One of the things which helped businessmen to make up their minds as to the benefit to be received from such a lighting program was the installation, before the first hearing, of a new standard beside an existing standard for the sake of comparison. This also gave the townspeople a chance to see what an improvement could be made.

During the entire campaign to secure this new lighting, the local paper, the Everett Herald, continually supported the project, and it also gave the completed project the widest publicity. A lights-on bargain night was held by the merchants, at which times the lights were officially accepted by the city.

The project was so successful that businessmen in other sections of the city, not covered by this first LID, are already discussing the possibility of getting other such projects underway for their particular area.

One lesson learned by the engineer department relative to reducing costs of such an installation deals with the use of existing conduit. The cutting of pavement and replacing it was one of the most costly parts of the project. The engineers are convinced that the use of overhead wiring would cut down tremendously on this part of the project cost. They reason that since the standards are so high, the use of overhead wiring would not be unsightly, and would be high enough not to interfere with traffic in any way where it might be necessary to locate it across intersections.

Of course, the final decision on cost remains with the businessmen who will have to pay it. But one thing is certain, and that is that Everett will soon have one of the most modern lighting systems of any city in the nation, thanks to the cooperation of the city and its merchants.

SOLVING OUR

ADOLF D. MAY,

Associate Professor,

Highway Traffic Safety Center,

Michigan State University

MUCH ATTENTION is being given to the development of the interstate highway system and to its urban connectors. This development is urgently needed, but equally important is the need for solving the parking problem which exists today in almost every community in our country. The improvement of highways and streets will aggravate the parking situation, and the lack of inadequate parking will prohibit the urban streets from functioning properly. A trip does not originate on the expressway, nor is its destination an off-ramp. The highway and traffic engineer must be as interested, active and concerned with the provision of terminal facilities as he is with movement facilities.

The phenomenal growth in the use of the motor vehicle as a form of transportation is the primary reason for the parking problem. The automobile accounts today for more than 80 percent of the passenger miles travelled. The vehicular registration in the United States as late as 1940 was only 32 million vehicles, while by 1960, the registration will be approximately twice as great.

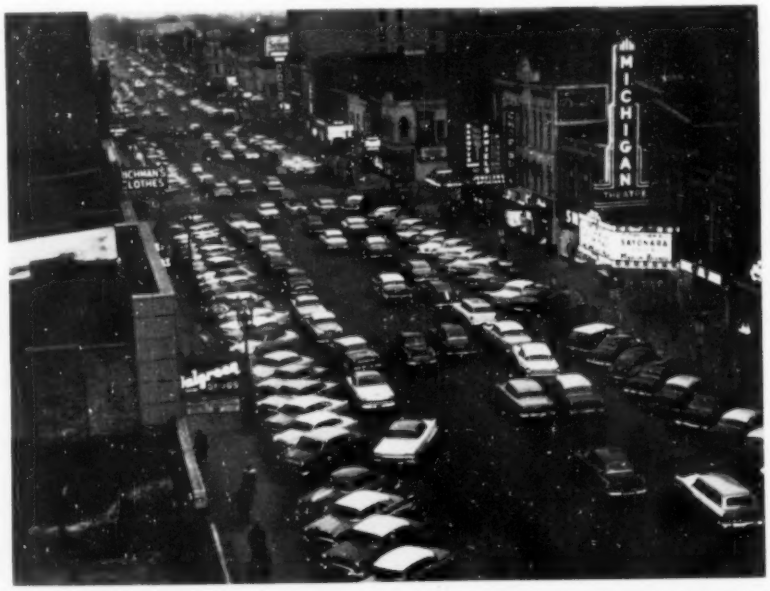
The second reason for the parking problem is the conflicting interests of the many groups in the community. The retailer wants customer parking in front of his store, while the traffic engineer wants movement. The shopper wants short-time parking, and the employees want all-day parking. The fire department wants rapid access to fire hydrants, alleys and buildings, and the transit people want freedom from interference and curb space for bus stops. The trucking companies want loading and unloading zones, and taxi companies want taxi stands. The private garage owner wants curb parking reduced or eliminated, and the police department wants the type of parking which will facilitate enforcement. Until the interest groups begin thinking of the community rather than of themselves and using the yardstick "the greatest benefit for the most people", rather than "the greatest benefit for me", the problem cannot and will not be solved.

Who is Responsible?

Who is responsible for parking in your community? Is it one person, or a group, or is it like other communities—almost every city governing body? The police are generally responsible for enforcement and the city planner for zoning regulations pertaining to parking. The traffic engineer makes parking studies, locates needed parking facilities, and designs them, while the city engineer constructs and maintains them. And finally either the mayor, city council, or city manager makes the policy decisions which affect the present and future parking facilities. Until the responsibility for the improvement of parking is delegated and the necessary authority given the parking problem will remain unsolved.

One would not think of allowing airplanes to park on the runway, nor would one permit water to be stored in the pipeline. And yet in highway engineering we allow this to happen. Not only do we permit parking on our streets but where the movement problem is most critical (in congested areas), the parking demand is the greatest. When the demand for movement is less than the street capacity, then parking can be permitted. As movement increases, the demand for parking increases and, consequently, the magnitude of the problem increases exponentially. Parallel parking on a two-directional undivided 45-ft. downtown street reduces the street capacity by 90 percent. The street would have to be widened 18 feet on each side in order to permit parking and still have the capacity of a 45-ft. street without parking. As the need for the added capacity arises, off-street parking facilities must be provided since the most economical solution is to prohibit parking on the street and to provide off-street parking.

The parking characteristics of our travelling public add complexity to our problem. The public is willing to walk only very short distances. For instance, in a community of 25,000 people, 60 percent of the parking public walks a distance of one block or less, while 95 percent of the people walk a distance of two blocks or less. The public parks



● **CONFLICT between the movement of traffic and on-street parking is illustrated by this view of congestion on a busy street, even when it is an unusually wide one.**

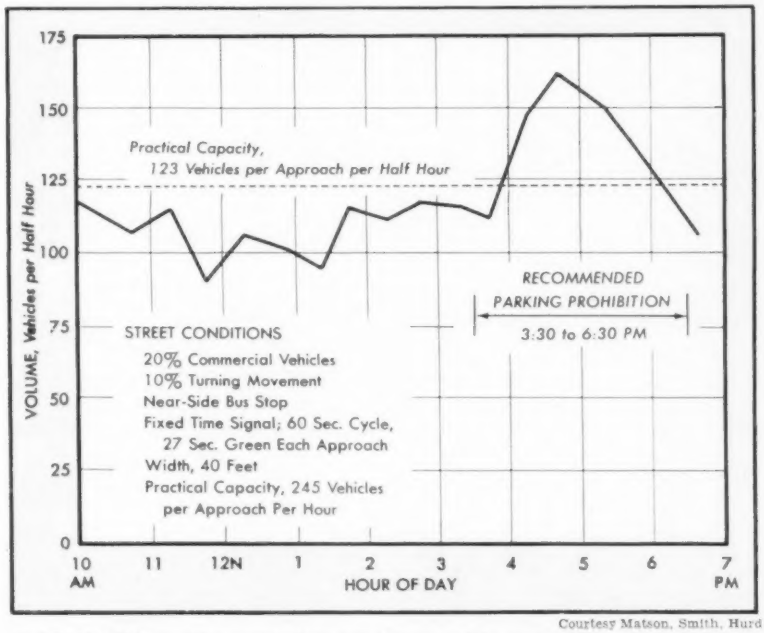
PARKING PROBLEMS

from one minute to all day, and we sometimes lose sight of the fact that the measure of parking usage is space hours occupied. For instance, one vehicle parked for eight hours occupies just as much space as sixteen vehicles parked for thirty minutes each. In one community of 10,000 people, 10 percent of the vehicles (all-day parkers) in the downtown area occupied about 50 percent of the space hours available. There is also the factor that parking, like movement, has very definite peaks and these peaks generally occur for only short periods of time. It is not economical to design for the absolute peak hour, and the public must be educated to accept inadequate parking facilities for short periods of time. It would be advisable to let the public know how their parking characteristics aggravate the problem and suggest to them ways in which they collectively could minimize their effect.

Steps In Solving

The four steps necessary in solving the parking problem are: 1) collect and analyze facts; 2) locate and design needed facilities; 3) inaugurate a financial plan and provide the legal implements; and 4) provide public education and obtain its support. The omission of any one of the steps may deter the solution of the problem.

Collect and Analyze Facts. Essentially the collection of facts consist of measuring the supply (inventory) and demand (survey) for parking, while the analyzation is the comparison of supply and demand. The parking study may also include an inventory of downtown streets and a traffic volume study. In the inventory study, information is compiled pertaining to the location, design, number, time limits, special uses, and rates of existing on-street and off-street parking. The area to be covered in the study is usually the central business district (CBD) plus the fringe parking area around it. A base map of this area is prepared and the scale of the map should be about one inch equals 200 feet. Each block should be numbered as well as the block faces, and each off-street lot should be given an alphabetical letter. The field survey consists of having a crew gather data for curb parking by counting spaces and measuring linear distances, and indicating on the field form the time limits, rates, meters, and location and type of non-parking curb use. The off-street inventory contains information as to type, ownership, rates, special restrictions, business hours, total area and arrangement, and number of spaces. The field data is summarized on the base map and tabulations are made of the number of spaces by block, by time limit, by on-street and off-street, and by public and private ownership.



Courtesy Matson, Smith, Hurd

● **PEAK-HOUR parking restrictions are determined by preparing a diagram of this nature. In this case, parking prohibition is recommended for the 3:30 to 6:30 period.**

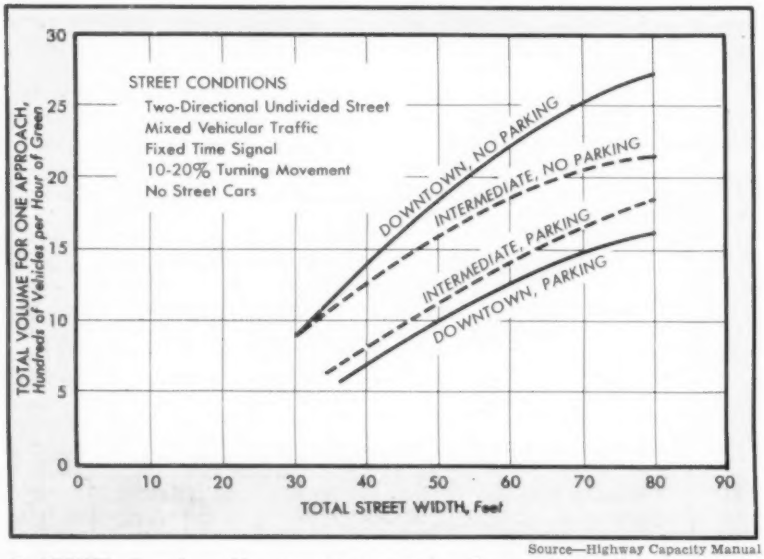
There are a number of methods which can be utilized in measuring the parking demand. The method selected depends upon the data that are needed and the funds available. The methods most frequently used are the cordon count method, interview method, post-card check, non-interview field study, land use studies, meter income method and the photographic method.

In the cordon count method, manual counters are stationed at the intersection of each street with the boundary of the study area. Under low to moderate traffic volumes, only two men are needed at each station—one in each direction. However, under heavier volumes of flow, more than two men per station may be needed. The manual counter counts the number of vehicles entering and leaving, by type of vehicle, number of persons per car, and time of day. Pedestrian counts may also be taken. The survey is normally conducted from 7 am until 7 pm during the middle of the week. The results obtained from the study would be the number of vehicles and persons accumulated in the parking study area during any period of the day, and an estimate of the space hours demand by the parker.

In the interview method, an interviewer is assigned to approximately fifteen stalls or a curb block face in the survey area. The interviewer records the type of vehicle, license number, time of arrival and departure of each vehicle, and indicates when parking regulations have been violated. The interviewer also questions the parker as to his origin, destination, and purpose of trip. Although this is one of the more costly types of parking studies, a

good indication of parking demand is obtained. Not only is the parking demand and time parked obtained for each block face and off-street facility, but also how far the parker walks, the purpose of the trip, and the origin of the trip.

In the postcard check, postcards are mailed to the homes in the community, handed out at the cordon line, or left in the vehicle parked in the parking study area. The person is asked to complete the questionnaire which may include origin, destination, and purpose of trip, duration and type of parking facility used, and route traversed, and requested to return the pre-addressed pre-stamped postcard. If an unbiased sample of adequate size is returned, then the results will be similar to the interview method.



Source—Highway Capacity Manual

● **EFFECT of curb parking on street capacity. Factors that influence capacity include street width, volume of traffic flow and traffic conditions, signals, etc.**

Non-Interview Field Study

One of the most popular methods of measuring parking demand is the non-interview field study. In this study a recorder is assigned an area of approximately four square blocks or an off-street facility of approximately 300 spaces, and he is supplied with a large scale map of his area. He circulates through the assigned area every thirty minutes, recording the last three digits of the license number of each parked vehicle on the map in the appropriate parking space. The survey is normally conducted from 7 am until 7 pm during the middle of the week. If stores are open in the evening and an evening parking problem appears to exist, it may be desirable to continue the study until 9 pm. In this study, the parking demand by block face is obtained as well as an indication of how long people are parking. The method is relatively inexpensive and the results are rather complete.

Since there is a correlation between land use and parking demand, if a land use study is made, then the parking demand can be estimated. The procedure is to locate each type of land use in the study area and place it on the base map. In addition to the normal data obtained in the land use study, additional information is obtained such as the number of seats in a theater or restaurant, the number of guest rooms in a hotel and the number of floors and floor area of office and retail buildings. Having the above data, factors can be applied to estimate the parking demand due to the type of land use.

A rather unique method of estimating the severity of the parking problem and to pinpoint the locations of highest parking demand, is the meter income method. It is only appropriate for cities which have parking meters, and most practical if the parking meters all have the same rate. The procedure is to remove the coins from all the meters in the downtown area and one week later remove the coins again this time recording the income of each meter. The meter with the greatest income would indicate the location of greatest parking demand. A contour map could be constructed connecting meters of equal income and hills (maximum income) would locate maximum demand areas. The income from the individual meters from one city could be compared with the meter income in other cities of similar size and type.

The technical person is always looking for tools which minimize the time and cost of collecting and analyzing technical data. One technique which is being introduced in the parking field is that of the intervalometer camera and the perceptoscope. The intervalometer camera is a specially constructed camera which will take photographs at any rate of time needed, generally from movie speed to one photograph every ten minutes. If the parking demand is in a rather concentrated area, the camera can be set up on a nearby building and with it set at a rate on one frame per ten-minute interval, photographs can automatically be taken. One roll of colored film costing approximately $12 per hundred foot could take photographs at a rate of one frame for ten minutes for about 650 hours. The data on the film would be analyzed in the office. Although the normal time and motion projector could be used to analyze the data, introduction of the perceptoscope as a new tool would improve quality and save a great amount of time. The data obtained from the photographs would be similar to the data obtained in the non-interview field study. The advantages of the method is that only one or two men would be needed for the study and most of the work would be in the office.

If consideration is being given to the reduction or elimination of on-street parking, then an inventory of the downtown streets and a traffic volume study should be made. The street inventory should provide sufficient data in order to determine street and intersection capacity, and the traffic volume study should provide the hourly volume flow on the major streets for a typical weekday.

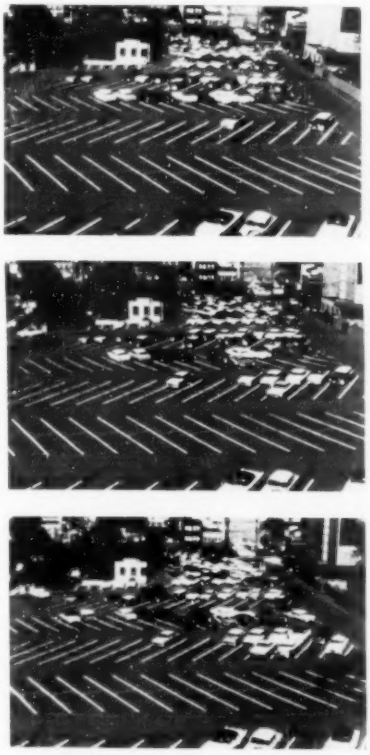
Locate and Design Needed Facilities. If the analyzation of the facts indicate a deficiency of parking space, then the second step is to locate and design the needed facilities. In almost all communities today we are unable to add parking spaces on-street and consequently the following discussion will be limited to providing off-street parking facilities. The data obtained in the studies discussed in the previous section indicate the location where additional parking is needed as well as some indication of the number of spaces deficient. Present demand for parking space is ex-

panded using predicted population or vehicular registration estimates. It should be emphasized at this point that the development of parking facilities which cost the least (right-of-way and construction costs) are not necessarily the most economical. In fact land which can be purchased at a relatively low cost may indicate little traffic generation and, consequently, small demand for parking. Another rule of thumb to use in locating parking facilities is that they should be not further than a block and a half away from the central core in a community of 25,000 people and not further than approximately three city blocks away in a city of 200,000 people. Using the distances indicated above, a land evaluation study should be made of the area and the data should be plotted on a land evaluation map. This may help locate land which is close to the parking need and yet is reasonable in cost. Areas at the rear of offices and buildings and the internal portions of large blocks are potential economical sites. Consideration should be given to such factors as adjacent rundown property, inadequate lighting, steep grades, parking areas across railroad tracks, and inconvenient access to arterials which may prove to be detrimental for a good parking facility. Having selected several potential sites, the estimate of the cost of land, construction and operation; estimate of use and revenue; study of traffic problems which may result from the new facility; and access-egress of the parking facility should be evaluated. If the parking facility is to be financed, then an economic feasibility study should be made to determine if the revenue will be equal to or greater than the annual cost.

Having decided upon the lot or lots to be improved, the exact dimensions of the land should be determined and design can begin. The three basic components of a parking facility design is access (also acceptance if attendant parking), storage, and exit (also delivery if attendant parking). The access to the facility should be designed to provide safe and rapid access with little or minimum interference to on-street movement. In-bound storage space should be adequate to prohibit cars from lining up and being stored on the adjacent street. In-bound lanes should be 12 ft. and the design of curves should consider the turning radii of the largest vehicle which will use the facility. The space for in-bound traffic would depend upon the type of parking facility, the entrance design, and the number of vehicles arriving during peak conditions.

Parking Stalls

Parking stalls in the facility should be a minimum of 8½ feet in width for self-parking and 7½ feet for attendant parking. The length of the stall should be 20 feet. Vehicles may be parallel parked, parked at 45 degrees, parked at 60 degrees, or parked at 90 degrees (perpendicular to aisle). In order to determine the approximate number of vehicles which may be parked in a given area, the area (in square feet) is divided by the area occupied by single vehicle (300 to 400 square feet). The 300 square foot figure could be used under ideal conditions. After several trials, a particular layout will result with a maximum number of parking spaces available and a convenient access and egress to the parking spaces.



● **PHOTOS taken by intervalometer camera at five minute intervals from 8:30 to 8:40 a.m. This is a useful way to check occupancy of a parking lot.**

One of the new interesting innovations in layout design is the use of double-barrier parking strips. This is an attempt to keep each car centered in its parking space and allows an equal spacing between vehicles. In the Northland shopping center located in Detroit the width occupied by the vehicle is 6½ feet and the space between vehicles is 2 feet.

Inaugurate a Financial Plan and Provide the Legal Implements. Parking facilities may be municipally or privately owned and operated. Until 1949 most of the off-street parking had been provided by private enterprise. Municipal facilities have found greatest favor in the smaller cities, and there has been a trend today toward more public-financed parking facilities.

Having collected and analyzed the facts, located and designed the needed facilities, estimated cost of construction, maintenance and probable revenue, a financial study is made. Normally a financial consultant is retained, and using the above available information, he devises a plan for financing the parking program. The four principal methods of financing public parking facilities are: (1) bond issue; (2) assessment; (3) parking meter funds; and (4) general funds.

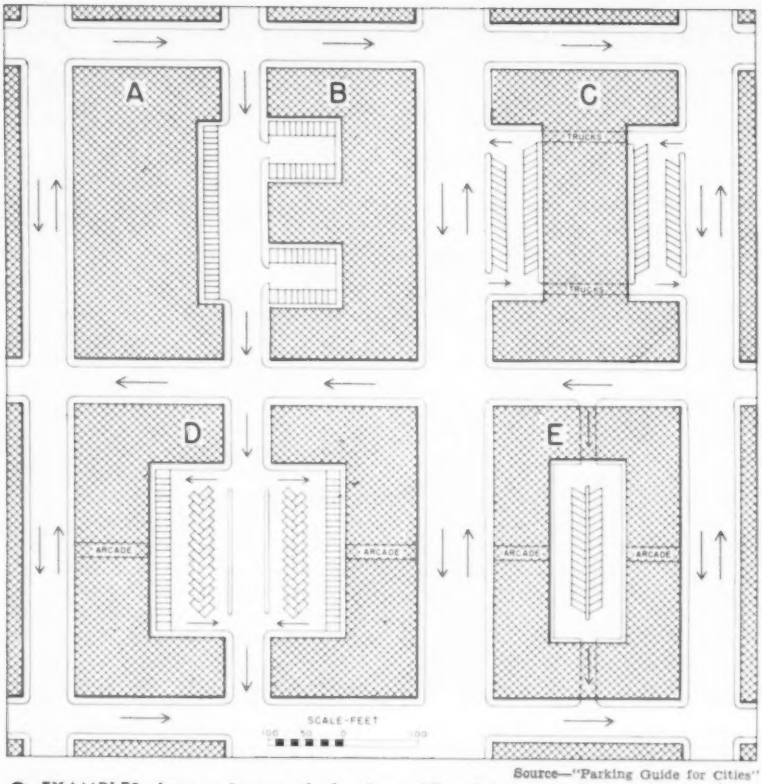
The bond issue method involves the selling of either general obligation bonds or revenue bonds. The general obligation bonds can be sold at a lower interest rate but a lien is placed against the city's assets, and it requires a 2/3 vote of the people. The revenue bonds require a higher interest rate, but the revenue from the parking facility only will be pledged to meet the financial obligation, and normally does not require a public vote.

The assessment plan is a method of assessing only those who benefit from the development (in proportion to the benefit) to meet the cost of providing the facility.

In some communities the revenues from parking meters are earmarked for the development of additional parking facilities. Therefore, the accumulated revenue can be utilized to pay for the development of off-street facilities in the future.

The general fund method uses money from the general fund to pay for the parking improvements on a cash basis. This is the most direct method of financing but has the disadvantage of competing with other community needs for allocation from the same general fund.

After the financial plan is selected, legal advice should be obtained to ascertain what legal steps are necessary to carry out the plan. Special attention should be given to local and state laws which may affect the parking improvement program.



Source—"Parking Guide for Cities"

● **EXAMPLES show various methods of providing interior block parking facilities.**

Provide Public Education and Obtain Its Support. The need for public support in developing a parking improvement program is just as important as the need for collecting technical data or locating parking facilities. Good parking improvement programs, based upon excellent parking studies, have failed because of the lack of public understanding and support. In almost every case, an informed public has been a supporting one, and consequently it is essential to provide for a public information service to give the public the facts needed to obtain its support.

The purpose of a public information service is to communicate to the public. Before communicating, five questions need to be asked: 1) What am I to communicate? 2) Why am I communicating? 3) How am I to communicate and with whom? 4) Where am I going to communicate? 5) When am I going to communicate? In summary—what, why, how, who, where, and when.

Communications may be considered as involving two types—mass communication and personal communication.

A public information service should be prepared to use both, although certain problems may require one more than the other. Mass communication involves the community as a whole whereas personal communications involve a small number of persons. The intimacy of the personal communication technique is more quickly effective, but its use depends upon the time available and the size of the group.

In dealing with segments or small groups of the public, care should be taken to establish the common interest mutual to the group. For instance, in an information program for the improvement of parking, the small groups might be city officials, downtown business men, professional groups, community organizations, and others. This enables one more precisely to evaluate the what, why, how, who, where, and when, and therefore make the communication more personal and pertinent to the interests of the group.

The best way to determine what information a group desires or needs is to put yourself in the other's place. As an example, in talking at a businessman's luncheon, the technical design features of the parking facilities are less interesting than the potential increase of business to be anticipated. The city officials will probably be most concerned with how much the project will cost and the source of financing. The potential "parker" will be interested in how much closer he will be able to park to his destination and what he will be charged. In summary, the interest approach depends upon the group interest.

There are three general methods of communication in a problem of this kind: 1) oral (luncheon speaker, committee groups, informal groups, etc.); 2) printed word (newspapers, brochures, flyers, etc.); and 3) the "heard" and "seen" word—radio and television. Each serves for various groups of people, and the presentation depends both upon the group of people and the media employed.

People participating in a program generally support it. The more people involved in a parking improvement program, the greater is this support. Not only will the individual support it, but personal contacts with other members of the community will multiply this support. In several communities, for example, boy scouts have helped collect the facts in the survey, and not only did an excellent job, but the work of the youngsters created parental and public interest in the survey.

In order to plan properly toward obtaining public support, a time schedule for public information should be made at the beginning of the study. Ideally this responsibility should be assigned to a qualified official or other responsible individual as an integrated operating procedure. When a decision has been made to make a parking study, the representatives from the various communication media should be informed of the study and asked for their help. Keeping the communication representatives informed, making them feel free to request additional information is the best way of getting their support.

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TWO-WAY RADIO SAVES TIME AND MONEY FOR PUBLIC WORKS DEPARTMENT

PHIL HIRSCH

A SUBURB 20 miles north of Chicago, Highland Park, Ill., is one of the relatively few communities in the nation using two-way radio to expedite operations of its public works department. Ralph Snyder, city manager, says "Without two-way radio, we'd need at least two more men and one more truck just to perform our routine maintenance operations; in emergencies, our reliance on contract forces would be two or three times as great as it is now."

The Highland Park installation, which has been in service approximately two years, embraces a base station at the municipal garage, and mobile transceivers in nine of the department's 19 vehicles. Four of the radio-equipped units are used by supervisory personnel; three others are trucks employed in water and sewer line maintenance operations; and two are used for street maintenance in summer, snow and ice removal in winter.

A 10-in. snowstorm that occurred in Highland Park on Jan. 9-10, 1957 illustrates graphically how two-way radio is able to expedite public works operations in an emergency. Snow began falling about 2 pm on Jan. 9, and a short time later the salt spreaders and snow plows were at work. By 5 the next morning, when the snow had stopped, some 10 vehicles were engaged in snow-removal operations. Five of them were supplied by outside contractors; the rest were municipally owned. Two of these latter units—a $1\frac{1}{2}$-ton International dump truck, and another, a $2\frac{1}{2}$-ton GMC—were radio-equipped.

By the morning of Jan. 10, a majority of Highland Park's streets were passable to traffic. However, many blocks were filled with stranded cars, preventing the plows from getting in. Gradually as motorists were able to get private tow trucks to move the vehicles out of the way, these bottlenecks were eliminated. But the problem of cleaning away the snow remained. It was at this point, to quote one Highland Park official, "that our two-way radio system proved to be worth its weight in gold."

Since the tow trucks were operating on a first-come, first-serve basis, the streets they readied for plowing were scattered all over the city. Drivers of the plows had no direct contact with the trucks. Under ordinary circumstances this would have created a prolonged delay in removing the snow, as well as excessive labor and equipment costs, explains Superintendent of Streets Andrew C. Beck. The plows would have had to cover each section of Highland Park several times removing snow from a few streets here and there each time. In a situation like this, the snowplow would not arrive until sometime after the tow truck had departed from a given block, causing many complaints from residents.

Virtually all of these difficulties were eliminated with two-way radio. Police cars were stationed throughout the city; officers in these cars, together with Highland Park residents, contacted the public works office as soon as a given street was free of stranded autos. The office then contacted the snow fighters. Two plows—those equipped with mobile transceivers—could be reached directly. The others received assignments from the four radio-equipped cars and trucks assigned to public works department supervisory personnel. These latter vehicles were stationed near the snow plows lacking radio and acted as relay stations. Thus, the movements of the whole snow-plow fleet could be coordinated with the operations of the tow trucks.

● **CONSTANT contact with the office and with the men in the field is maintained by Andrew Beck, Sup't of Streets, left.**

A doctor resided on one of the streets blocked by snow; he was due in the operating room of a local hospital, but couldn't leave his home because of the deep drifts. On another street a woman about to have a baby was likewise snowbound. As soon as each of these streets was cleared of stalled cars, however, the public works office contacted a nearby plow by radio and sent it to the scene. In both cases, say Highland Park officials, the time saving produced by the mobile radio system averted a possibly serious emergency.

By 11 am, on Jan. 10, six hours after the storm had ended, all streets and municipal parking lots in the village were open to normal traffic. According to Street Supt. Beck, doing the same job without radio would have taken "at least 12 hours longer, and probably more."

Ten-inch snow storms do not occur very frequently, of course; but Highland Park's radio system plays an equally important role in the day-to-day operation of the public works department.

Movement of Maintenance Forces

It produces one important benefit by cutting down the time required to move maintenance forces from job to job. Instead of hunting up a phone, or bringing his men back to the office, the crew foreman uses mobile radio to obtain the location and other detail of his next assignment.

Radio facilitates delivery of tools and equipment to personnel in the field. During the summer months, for example, the street department loads its two radio-equipped dump trucks with tools, sand, gravel, cement, lumber, and other materials, and sends each unit out to a number of locations where streets are being repaired. Sometimes one vehicle falls behind, or gets ahead of schedule; occasionally it runs out of material en route. Through radio contact between the public works office and each driver, the delivery schedule can be adjusted to compensate for these situations. As a result, delay in completing street repairs is minimized.

Often, tool and equipment needs can't be completely determined until after the crew reaches the jobsite and goes to work. Not long ago, a water pipe maintenance crew was called to rectify what looked like a minor leak in a house service line. In the process of eliminating this leak, they found an underground pool that led them to a major break in the supply main. The foreman contacted the public works office by radio and asked that a tractor with a backhoe attachment be dispatched. As it turned out, the equipment was finishing up some excavation work on a job only a short distance from where the water pipe maintenance crew was. A radio-equipped truck was also at the excavation site. The public works office contacted the tractor driver and gave him his new assignment. Fifteen minutes after the foreman had made his call, the tractor was at work excavating the area above the broken main.

Emergency Service Calls

Aside from its ability to expedite routine movements of men and materials, two-way radio also permits quicker handling of emergency service calls with less disruption to regular maintenance operations, Supt. of Public Works Edward Hart reports. The public works department receives many such calls throughout a typical working day, when all maintenance crews are usually in the field. Most often, the calls involve broken water or sewer pipes, pavement defects, and malfunctioning traffic signals. Radio not only permits immediate contact with the proper repair crew, but it gives the dispatcher in the public works office selectivity. He can assign the job to the personnel nearest the scene of trouble. Also, one or more supervisory officials can be consulted when necessary, even if they are out in the field.

Radio permits trucks and tools that break down in service to be repaired and returned to duty in less time, adds Supt. Hart. Highland Park, like other communities, suffers most from equipment failure on the job during the wintertime, when the need is generally greatest. If a tire chain breaks or a truck gets bogged in snow, the driver can obtain help in a few minutes by using the mobile transceiver in his cab to contact the central garage. There's no delay, Supt. Hart explains, while a phone is located. Also, when necessary radio can be used to prevent the equipment failure from delaying completion of a job. For while the stalled truck is being rescued, a fresh vehicle and driver, dispatched by radio, can be pulled off another assignment and sent to the spot.

Highland Park's two-way radio equipment, manufactured by Motorola, operates on a frequency of 460.1 megacycles. The desksize transmitter-receiver in the public works office is connected to a 75-ft. transmitter adjacent to the municipal garage. From this height messages can be beamed to any of the nine radio-equipped public works vehicles almost wherever they may be in the city, which has a total area of approximately 12 sq. miles. A small section studded with deep ravines near Lake Michigan is the only place where signal reception is poor.

The village rents its radio equipment. Cost comes to about $150 a month—$26/month for the base station facilities at the municipal garage, and approximately $13.50/month for each of the mobile transceivers. Highland Park officials agree that this cost is more than justified by the benefits the city has obtained.

● **INSTRUCTIONS are being relayed to water pipe field crew regarding emergency service call that has just come into the Public Works' Dep't. office at the garage.**

ORGANIZATION and EQUIPMENT for SEWER MAINTENANCE

T. S. FORD
and
FRANK J. O'DONNELL,
Engineers,
Bureau of Sewers,
Chicago, Illinois

THE RELATIVELY flat terrain and the shallow natural drainage system of Chicago's 214 square miles add greatly to its problems of sewer maintenance. The elevation of much of the area of Chicago is between five and thirty feet above the level of Lake Michigan and about 25 percent of the total requires pumping of storm runoff. In one case, even where the elevation rises to 70 ft. or more, the distance of over 11 miles to an outlet gives an average slope of only 0.0010. With this slight fall, it is difficult to secure self-cleaning velocities of three feet per second in combined sewers and to provide sufficient cover (about seven feet) at the high ends. Chicago's first sewers were built in 1856 in and near what is now the downtown or "Loop" section, which was so low in some places that street grades were raised several feet to allow a proper pitch in the sewers.

Commissioner for Water and Sewers, James W. Jardine, is given every assistance from the Mayor and other city officials in developing a finer department for serving the taxpayers more efficiently. The Bureau of Sewers of the Department of Water and Sewers is charged with cleaning, repair and operation of some 3,640 miles of sewer, 193,500 catch basins and 133,000 manholes. The activity is under the direction of Thomas D. Garry, Deputy for Sewers, and requires the services of nearly 900 men of various talents. At any hour of the day or night, seven days a week, the bureau can send a crew or crews to take care of any sewer problem which may arise. A complaint truck with a foreman, subforeman and two or three laborers is dispatched to every fire of 2-11 or greater severity, to assist firemen by keeping street inlets clear. In case of a 4-11 fire, the Deputy himself is on the scene to direct his men.

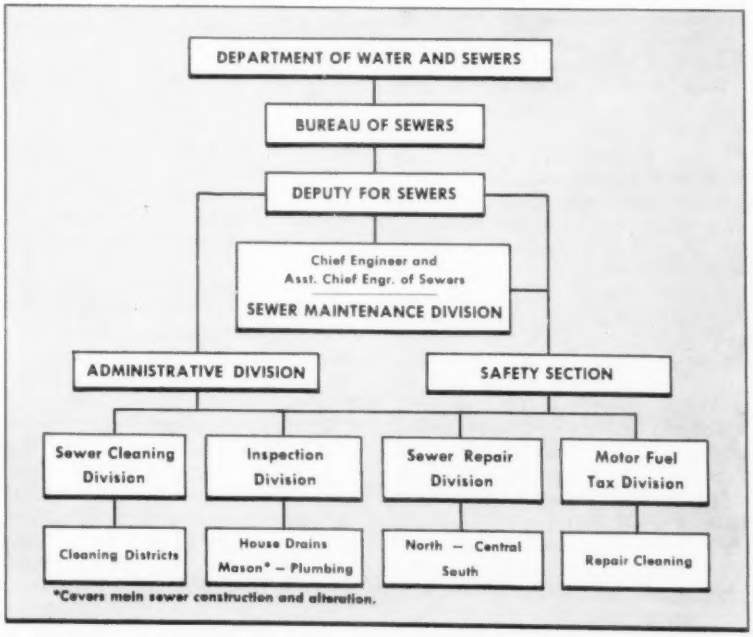
The nerve center of the bureau's operations is on the fourth floor of the City Hall in the heart of the loop. Controlled from this office are three repair districts, seven cleaning districts, one combined city-wide district, and other maintenance activities. Areas of the cleaning districts vary with the density of population or the amount of business or industry.

District Organization

Of the seven cleaning districts, the first, covering approximately fifteen square miles, is the smallest but the most active. Three work shifts are maintained to service the downtown area which is the most difficult to work in and the most liable to trouble, because of the heavy demand on sewers by the high-density daytime population and an ever-increasing air-conditioning load. Relatively few water-recirculating air conditioning systems are used in Chicago.

The first operation to clear a blockage in a downtown sewer is usually to use the water-flusher. This is a 2700-gallon tank mounted on a trailer with a truck tractor. Its contents can be discharged in approximately 45 seconds through a 12-in. hose and butterfly valve arrangement. Compressed air at 60 pounds, stored in two 40-gallon tanks on the trailer, is released simultaneously with the water to increase turbulence. If this method is not successful, power rodding, augering, or scraping with the power-bucket machine is tried. Digging up the troublesome section is a last resort.

Heavy traffic and maximum flow during the day forces this district



● CHART showing organization for sewer maintenance operations in Chicago.

to do most of its work at night and, since all the other district yards are closed at night, the first district also sends work crews to any part of the city for emergency service after regular hours. Although each yard stores some tools, machinery, spare pipe, castings and so forth, the first district yard serves as a central depot by carrying a fuller inventory of necessary materials and equipment.

In the seven numbered districts, the Motor Fuel Tax District and the Construction Division there are 79 gangs totalling 490 men. Equipment includes 76 hired trucks; 14 eductors; 8 compressors; 4 flushers; 5 power rodders; 12 pair of sewer scrapers; 16 pumps; 6 "orange peel" catch basin cleaners; a truck crane; and a tractor with high lift loader. In addition, cranes, hoe shovels and more trucks are rented as needed.

A typical cleaning district has a foreman in charge, one or two assistant foremen, several clerks, subforemen (usually one working with each gang), two hoisting engineers to run the orange-peel catch basin cleaner and the power bucket scraping machine, yardmen and inspectors (varying from 5 to 16), 3 motor truck drivers and 3 to 4 laborers per gang. Eight or nine trucks are hired on a contract rental basis.

Catch basins are cleaned by eductor, orange-peel cleaner and by hand. Most districts have 4 or 5 gangs cleaning basins by hand, other gangs using the eductor, orange-peel, water wagon, or power scraper. Debris from catch basins is carried to special dumps previously arranged for by the bureau.

Routine visual inspections of catch basins and sewers are carried out by inspectors in each district to schedule future work and to note if repairs are needed. In order to be sure that basins are not blocked by parked cars in congested areas, the districts coordinate their work with the cleaning operations of the Bureau of Streets which posts "No Parking" signs along one side of a street the day before street-sweeping machines are to be used.

Repair Work

The city is divided into three repair districts. The central district is staffed by a Foreman of Bricklayers, a lath-and-form maker, three carpenters, eight hoisting engineers, a clerk, truck driver and eleven gangs. A typical gang consists of a bricklayer, three laborers and a truck with driver but this set up may vary as circumstances require. Ten gangs work in the north district and fourteen in the south district. Each of these districts is also under a Foreman of Bricklayers but has only four hoisting engineers and no carpenter or form man as in the central district. These repair gangs draw supplies from the cleaning district yards convenient to their work. When needed, a truck crane, air compressor, or tractor with high lift is available.

The city-wide district, (previously mentioned), is known as the Motor Fuel Tax Division. Its duties include both cleaning and repair of sewers in arterial streets and state and county highways in the city. This division has a separate yard for materials and equipment and keeps its costs, which are charged to State Motor Fuel Tax allotments, completely apart from those of the other divisions in accord with statutory requirements. Manpower in this division is distributed in much the same manner as in the cleaning and repair districts. Fifteen gangs are used—nine repairing manholes or catch basins, four cleaning catch basins and two scraping sewers. An orange-peel catch basin cleaner and two sewer scraping machines are used as well as nineteen hired trucks.

During the construction season, skilled gangs are taken from the repair division to form a construction unit assigned to building such new sewers or extensions of existing sewers as the City Council elects not to let out by contract. These have ranged from 10 inches to as large as 8½ feet in diameter. If the equipment owned by the bureau is too light for a particular job, a machine of sufficient capacity is rented from one of the local contractors.

Synchronization of all the operations in the bureau is achieved by personal contact between the Deputy or his superintendents in charge of the divisions and the foremen and assistant foremen in the districts. Each morning the foremen of the three repair districts report at the city hall for instructions and lists of the day's work schedule. They also call by telephone as often as necessary when in the field. Each cleaning district foreman has a personally owned automobile equipped with radio telephone, which enables him to call in or to be called by the radio-control center of the Department of Water and Sewers. Seven eductors are equipped with two-way radios. Sub-foremen of repair gangs in the field telephone the main office periodically to report their locations and pick up any emergency assignments.

● **CATCH BASIN cleaning with an orange-peel bucket mounted on a truck. Eductors are also used as well as hand equipment. Debris goes to special disposal dumps.**

In both the cleaning division and the repair division, work is done principally on a complaint basis since by far the greater part of the sewers functions normally for long periods. Certain phones in the main office are designated for receiving complaints from private individuals, companies, or public utilities. Each call is written up as to nature of complaint, location, and name of complainant. According to their urgency, these calls are relayed to the appropriate cleaning or repair district which investigates to determine if it is a sewer problem or if (as frequently) some other utility is involved. A record of every

complaint and its disposition is kept. Many complaints come to the office by letter, either directly, or through the Mayor's Office of Inquiry and Information, or some other agency. These are relayed to the district concerned and reply is made explaining the action taken on the complaint.

Motor Fuel Tax Division work is done on a systematic basis. Estimates indicating the approximate number of manholes or catch basins to be repaired and/or cleaned and the number of feet of sewer to be scraped or repaired are made for each section of arterial street to be worked in and are sent to the State of Illinois for approval. These estimates are prepared by bureau engineers, well in advance of the contemplated work.

So far, we have spoken primarily of the outside maintenance carried on by various districts. Three more divisions exist in the bureau: Administrative, Sewer Maintenance, and Inspection Divisions.

The Administrative Division is staffed by the administrative assistant to the Deputy for Sewers and a number of employees with various functions, as superintendents of construction, of out-of-town sewer connections, and of equipment, a personnel officer, and clerks, stenographers, etc., to carry out the necessary paper work.

All of the engineers, draftsmen and technical help are assigned to the Sewer Maintenance Division which handles all the work outlined below as well as furnishing plans and engineering supervision for sewers built by private contract.

Records System

Because the Bureau is the responsible custodian of all sewers within the city, any plans for new work or for alterations to the system involving sizes of eight inches or more, must be examined for approval before work permits may be issued. This covers plans by other city departments or by county, state, federal, or private agencies. Expressway projects have created problems of loss of head by introducing inverted siphons or flattened sections beneath depressed roadways and by diversions for approach ramps, etc. Such changes frequently entail special provision for maintenance operations and usually some form of separation of dry-weather and storm flow.

Demolition for these projects and for slum clearance and housing creates other problems in rearranging sewerage and in properly sealing abandoned sewer lines and manholes and catch basins.

From the beginning of sewerage in Chicago, street grades were important to sewer design in order to secure sufficient cover over the pipes at their far termini. The Bureau of Sewers, for that reason, either originates or passes on proposed grades before they are established by city ordinance. Its bench and grade section builds new monuments and runs the precise level network and maintains thirteen atlases showing the curb grades established by city ordinance and a card file of all bench monuments, standard and sub-standard, of which a total of 1833 are scattered throughout the city. Of these, 336 are standard monuments and 1497 are sub-standards located on buildings or other convenient structures.

Thirteen other atlases, available for public use, and maintained by the drafting section, show the existing main sewer system. This record shows locations, sizes, and elevations of sewers as final measurements are turned in by field engineers.

A third set of 31 atlases, on 50 and 100-foot scales, show individual lots and blocks in the city on which are posted references, by book and page numbers, to several thousand inspectors' note-books covering the installation of building connections to the street sewers since the Chicago Fire of 1871, and any alterations.

Safety and Inspection

Safety in all divisions is heavily stressed by the Bureau's saftey engineer and his assistants. The Department of Water and Sewers (and, consequently, the Bureau of Sewers) is a member of the National Safety Congress. As such, all standard safety procedures are followed and necessary equipment is purchased, such as safety helmets, gas masks, explosimeters, etc.

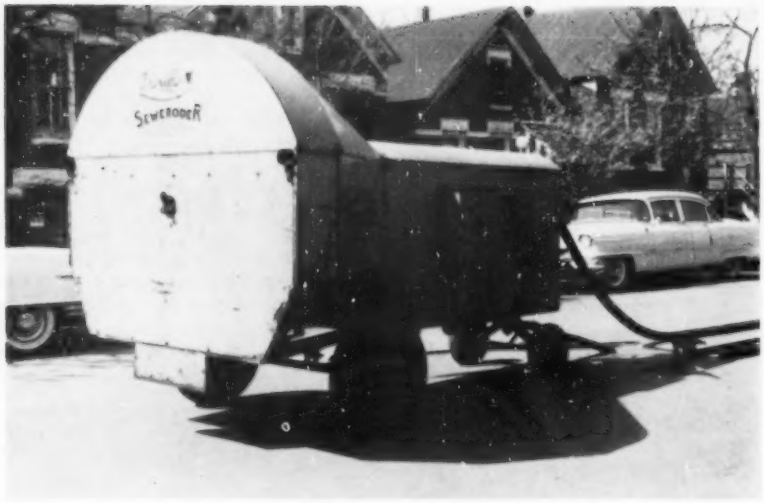
Inspection of all sewer work in the city is essential for trouble-free service to individuals and industry. The Inspection Division can be broken down into three categories: House Drain Inspectors, Mason Inspectors, and Plumbing Inspectors. All are empowered to close down a job if no permit has been taken out or if the work is not acceptable.

Each house drain inspector works in a specific area, usually five to six square miles, and the city is divided into forty such areas. A house drain inspector in charge and three supervisors oversee the field inspectors. Work is distributed from the main office to three house-drain district offices, set up within cleaning district offices. Inspectors call the city hall office twice a day in case emergency assignments need to be taken care of or instructions relayed. Notice of new construction is obtained from building permits and the inspector checks each site for new sewer work and asks to see the permit for such work. He prepares a sketch on a prescribed form, showing where the "stub" is located and where each trap, stack, or basin is built and turns the sketch over to the drafting section to be recorded in the house-drain atlas and later to be bound into a book.

● **CITY-owned equipment is used on much of necessary construction. Here a crane unloads a 72-inch concrete pipe.**

Mason inspectors are assigned to work where the pipe diameter is eight inches or more or where any adjustment of manholes or catch basins is made, as in street resurfacing operations. Their duties include inspection of sewer work in both private property and public streets whether done by private individuals or by public agencies. It is their job to insure use of proper materials, correct installation, and general adherence to plans as approved by the Bureau of Sewers. They keep their records in mason inspectors' record books giving dates of construction, size and quantity of pipe laid, location of sewer, manholes, catch basins, "Y" branches and stubs. These records, with the engineers' finals, are transferred by the drafting section to the atlases.

A mason inspector in charge is over these men and he, in turn, is under the Assistant Chief Engineer



● **POWER-rodding, augering or scraping are used for difficult sewer cleaning jobs. Digging up the blocked section is the last resort, and is usually unnecessary.**

who assigns work as plans are approved and construction is ready to begin. Where cast iron pipe is laid underground, one of the four plumbing inspectors in the bureau is assigned by the Assistant Chief Engineer. All these inspectors contact the main office daily by telephone or come to the office early in the morning.

Operating costs of the Bureau of Sewers are appropriated from the Water Fund of the City of Chicago, the City's share of the Motor Fuel Tax of the State of Illinois, City Vehicle Tax Funds, and from Sewer Bond Funds.

Motor fuel tax money is used exclusively for cleaning and repair of sewers and appurtenances in arterial streets and state and county highways. The "Motor Fuel" maintenance unit is self contained, using its own equipment, materials, and manpower; and the state audits all of its expenses.

Vehicle Tax money pays the salaries of mason inspectors who work on sewer alteration and adjustment for the pavement-resurfacing and reconstruction jobs done by the Bureau of Streets, and for repairing manholes and catch basins and replacing cast iron covers.

Money appropriated to Bureau of Sewers accounts from Sewer Bond Funds is used in construction of new sewers, mostly for the improvement of small areas in the city which have not yet received the benefits of the multi-million dollar auxiliary outlet-sewer program begun in 1947 to relieve flooded basements and underpasses in the city.

Since its inception in 1856, Chicago's sewer system has grown tremendously, yet most of the brick sewers, now from twenty-five to eighty-five years old are still in use. However, heavy traffic and other disturbances cause these older sewers to fail frequently and the Bureau is constantly on the alert to forestall these breakdowns if possible.

Almost every day, the Bureau of Sewers meets with some difficult problem but, undaunted, adheres to its slogan, "The difficult we take care of immediately; the impossible takes a little longer."

TESTING A BEARING PILE

MALOY QUINN, Clay County Engineer, Clay Center, Kansas

THE POPULATION of Clay County, Kansas, is 11,400 and its rural economy is wheat and corn in conjunction with a well balanced diversified farming program of cattle, hogs and chickens. Clay Center is the county seat and the Republican River bisects the County from the Northwest corner to the Southeast corner; in fact, the proposed Milford Dam would be approximately 1½ miles from our county line, and nearly 90 percent of the reservoir would be in Clay County. The terrain is gently sloping and average or better farm land.

The County has a total of 1268 miles of road which are parts of three systems: the State Highways, 68 miles; County and Secondary, 235; Township, 965; each is constructed and maintained by the particular authority noted. The only overlapping of function is the County's responsibility for bridges on the township system. There are over nine hundred structures of this type on the County and township systems.

In Kansas the Federal Aid Secondary Funds are allocated to the Counties to be matched fifty-fifty by county funds, either gas tax (there is sufficient returned to the counties to match) or other funds available. Plans are approved by the State Highway Department and construction supervised by them. It has been a pleasant and fruitful arrangement for us. Our share of the FAS Funds is approximately $45,000 annually, making a $90,000 yearly secondary program to supplement our regular programs. During 1957 we will have completed new construction and reconstruction projects valued at $228,000 total.

We had one particularly interesting project during 1957, that is, it was of particular interest to me because of a problem of testing a bearing pile in a pier for a 50-70-50-ft. reinforced concrete girder, 24-ft. roadway, bridge which we built on a secondary route North and East of Clay Center which was assigned the project number 14-S-115(8). Our County is 14th in the alphabetical arrangement of counties in Kansas. The "S" is for Secondary, the numbers being the sequence of projects and the section or units built on the route after the number was assigned.

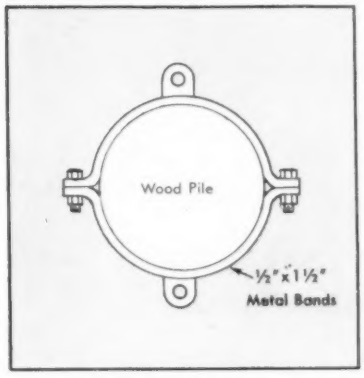
Preparing Plans

In preparing plans for this project we chose to use a state standard, as particularly adaptable to this location over Fancy Creek which has a drainage area of 63 square miles, considerable timber, and with high

water experiences of approximately six feet above the existing road. The span length of 50-70-50-ft. gave a good clearance for drift in the center of the stream, and an adequate water way.

We obtained the services of a Geologist and core drilling unit to determine footing or foundation requirements, and from these findings determined the required bearing would be sixty feet below crown grade and in hard gypsum. The first 38 ft. was silt and silt and clay with a 6-inch sand and gravel layer at the bottom. Then after passing through a few inches of limestone, there were 9 ft. of shale and finally 4½ ft. of gypsum.

It was decided to use piling in the footings. The plans called for 35 26-ft. untreated timber piles in the two piers and 12 55-ft. treated



● PLAN view of the couplings used to anchor test rig to four flanking piles.

timber piles in the abutments which were the quantities bid by the contractor. The construction was done by Ralph Forkner Construction Co. of Clay Center. Wm. Predmore, PE, and Resident Engineer for the State Highway Commission, who is co-author of this article, was the Engineer in charge of construction.

Driving the Piling

All piles were to be driven to a penetration in the shale overlaying the gypsum, and to a computed minimum bearing value of 18 tons per pile. The design bearing per pile was 16.08 tons. Piles were first driven for abutment No. 2 on the North; these were driven through approximately 12 feet of compacted embankment at the top. All piles exceeded the minimum computed bearing of 18 tons, ranging up to 21 tons. Then the hole was prepared and work began on pier No. 2.

On April 19, 1957, the Contractor drove piles No. 11 & 13 on pier No. 2. Computed bearing values of 13.8 tons and 12.2 tons respectively were obtained. (Required computed bearing was 18 tons.) These piles were driven to 6 ins. below pile cutoff. Pile No. 18 (37.50 ft. in length) was driven on April 22, to a depth of 37.50 ft. A bearing value of 16.9 tons was obtained. It was then decided to drive 5 additional long piles to a computed bearing of approximately 20-22 tons and the remainder of the piles were to be of plan lengths of 26 ft. Based on past experience, it was assumed that bearing values would increase as the pilings were driven into the footing and a total bearing of approximately 300 tons (which is reaction on this pier) would be obtained. On April 26, these longer pilings (except No. 3 & No. 5) along with the remainder of the 26-ft. lengths were driven.

Making the Test

Anticipated bearing values were not obtained and since footing design would not allow additional piling to be driven without considerable expense, the Contractor was asked to perform a loading test in accordance with Art. 59.54 (1955 Std. Spec). Piles No. 3 & No. 5 were driven on May 1. A 60-ton hydraulic jack was obtained and a loading test was performed on May 4. At approximately 11:30 am, the pile No. 17 was loaded to approximately 26 tons. A deflection of $\frac{1}{8}$-inch was recorded. This load remained on the pile for thirty minutes and then a pressure of 34 tons was obtained. A deflection of $\frac{1}{4}$-inch was recorded. This pressure of 34 tons was left on the pile for 4 hours after which it was entirely removed. No additional deflection was recorded during this period. The top of the pile returned immediately to its original position after the pressure was removed and this $\frac{1}{4}$-inch deflection is, undoubtedly, entirely due to compression of the pile. No upward movement of piles 2, 5, 15, or 16 could be recorded during the loading.

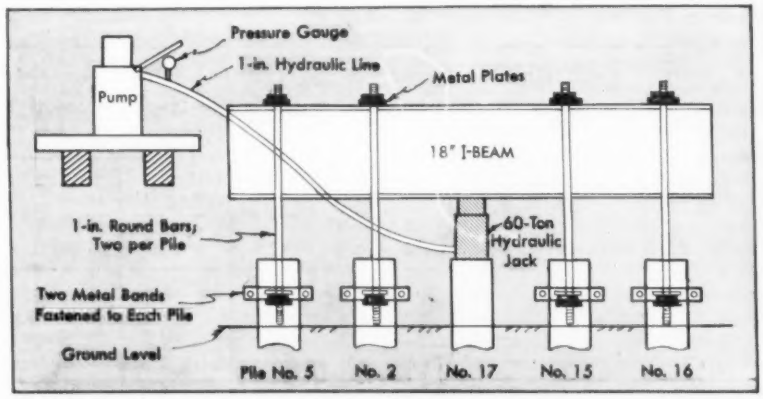
As no failure took place during this loading, a realistic projection of bearing values of the remainder of the piles cannot be made in relationship to computed bearing values obtained at time of driving. However, it must be assumed that the piles in this footing have sufficient bearing capacity for which this footing has been designed.

Our pier No. 1 and abutment No. 1 both were satisfactory. The bridge was completed and opened for traffic July 18, 1957. Its lines are good, there has been no settlement to this date as proven by a recheck of center-line elevations. The time required and cost of this test were as follows: Labor $133.50; liability and compensation insurance and social security $13.77; 10% profit $13.35; and 10% superintendence $13.35. The total labor cost was $173.97.

Metal used in making up the loading device was the only material involved and the cost of the material which came from the Contractor's stock was $35. Ten percent was allowed for profit, making a total material cost of $38.50.

Cost of the loading jack rental and freight was $38.02, and a ¾ cu. yd. crane was used during the loading and setting up and dismantling the loading device. Crane rental was $91.20, making a total equipment rental of $129.22. Recapitulation of the force account was labor $173.97, material $38.50 and equipment rental $129.22 for a total cost of $341.69.

There are probably many other methods of testing bearing piles, but this was a new experience with us, it was reasonable in cost and gave the required results.



● SKETCH of rig used to test Pile No. 17. A load of 34 tons was maintained for four hours. After removal of pressure top of pile returned to its original position.

DON'T Ignore SOIL STUDIES

M. D. MORRIS,
Vice President,
TESTlab Corporation

FOR SEVERAL hundred years men have studied soils for various reasons. Coulombe, Bousinesque, Sooy-Smith, and Terzaghi have each made great strides in applying to construction significant discoveries about soil behavior under varying conditions of external and internal stresses. Yet not until the epoch of World War II was credence given the thought of insuring the project by engineer-studying what was to be its permanent support.

To bring this point more clearly into focus for all even indirectly concerned with the business of construction, hereinafter follows a rather basic, concise, yet comprehensible, symposium on many aspects of soils studies. This is the "why"—not the "how." How to accomplish these things may be found in any good laboratory manual; the specifications of ASTM, AASHO, etc.; or in government agency standards. The theory is outlined in many fine, up-to-date texts. All specialists in their fields, the authors wrote on the subjects of taking good soil samples; testing them properly; using the results in the working job; and the tools needed to do it; then on to more specific applications to highways, flexible pavements, piles, bridges, tunnels, buildings, and earth dams. Finally to what's new, in-place paving by chemical stabilization; and large area studies by air photo interpretations.

Due to space limitations, there are some topical omissions notably in the sanitary engineering field which depends on soils studies for plant location in doubtful areas; settlement support under large diameter long mains; percolation and permeability studies; settlements of large diameter tanks; footings for elevated tanks; and electrolytic action determinations.

Because soils are not uniform, they are unlike the other two main construction materials (steel and concrete), and somewhat more specialized educational preparation is required before being able to cope with them. About this, Dr. Donald M. Burmister, Professor of Civil Engineering at Columbia University in New York says:

"The major educational emphasis in soil mechanics should be on developing fundamental knowledge and principles and on more thoroughness and comprehension. Conceptions of adequacy should be revised consistently upward, fully to keep pace with scientific advances by removing ignorance factors and elements of guessing, from thoughts and practices.

"The soil engineer should be fully cognizant of: first, the character and range of environmental influences; second, their favorable and detrimental aspects, and relative dominance and control; third, soil susceptibility and identifiable soil characteristics and properties that govern; fourth, the kind and degree of modification caused by construction of structures; and fifth, how and to what degree conditions can be improved in practice."

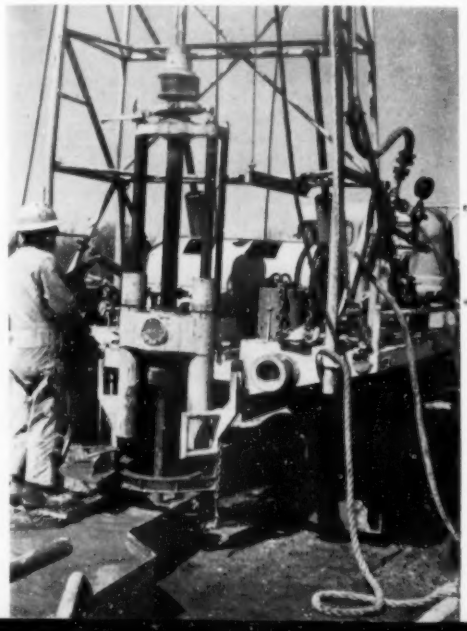
FOUNDATION EXPLORATIONS, DRILLING and SAMPLING

DAVID M. GREER,
Greer Engineering Associates

A TEST boring is, essentially, a hole in the ground, made for the purpose of obtaining information about the kind, arrangement, and consistency of the materials which will be stressed by a proposed structure. The equipment with which this boring is made varies from the post hole digger or hand auger (used to get shallow disturbed soil samples) to the core drilling machine, used to obtain undisturbed samples of soil or rock to depths of hundreds of feet.

The kind of equipment that should be used depends upon the nature of the structure and the kind of material that is expected to be encountered in the boring. For investigation of the depth of a soft clay or peat layer, or a marsh deposit, a "plug" type sampler, which is little more than a probing rod, carrying a hollow point closed by a retractable plug, may suffice. On the other hand, if the soft layer will have to carry the load of a structure like a highway embankment or a bridge approach, a drilling machine capable of taking undisturbed samples of soft soil, 3 ins. or more in diameter, may be required. If it is desirable to have a sample of the rock underlying the soil of a site, the drilling machine must be of the rotary type, and must be equipped with diamond

● **DRILLING machines of this type are used widely in foundation explorations.**



bits for cutting rock core samples.

Undisturbed Sampling. Wherever the soils that may be called upon to carry a structural load are soft, or weak, or compressible, or composed principally of clay, their behavior under load can be predicted only from the results of laboratory strength and consolidation tests on undisturbed soil. A clay, or cohesive, soil has an internal structure, which is the product of many events—loading, unloading, drying, soaking, bleaching, and many others—in the geologic past. This structure governs its strength: disturb it, and the strength is changed, usually reduced; remold it, and the soil's compressibility is altered, usually increased. This is why the soils engineer requires undisturbed samples of soil for test.

Many sampling tools, most of them usable with nearly any core drilling machine, have been devised for taking undisturbed samples of cohesive soils. The simplest of these, and one of the most effective, is the Shelby tube sampler, which is a thin-walled metal tube with a sharpened edge, which is forced into the soil by application of steady pressure (not by blows of a hammer). The cutting edge of this sampler is slightly smaller in diameter than the inside of the body of the tube, thus assuring that the sample will not slide out of the sampler while being withdrawn from the boring.

Two developments of the past few years, combined with Shelby tube sampling techniques, have produced an improved sampler with procedure which is even capable of producing undisturbed samples of sand below the water table[1]: the "Piston" type sampler, and the technique of keeping the boring filled with a clay slurry (drilling mud), instead of driving a steel casing to keep the hole from collapsing. Another device, which has been used to take continuous undisturbed clay samples as much as 30 feet in length, is the Swedish Foil Sampler.[2]

The Standard Penetration Test. For sampling sands and other cohesionless soils, the most widely used sampler in America is the split-barrel sampler, which is driven into the soil by blows of a 140-lb. hammer dropped a distance of 30 inches. The number of these hammer-blows required to cause 1-foot of penetration of the sampler is recorded, and serves as a rough index of the density of the soil. The sample obtained by this procedure is completely disturbed, but serves for classification of soil types and some of the simpler tests that are applicable to disturbed soils. The penetration records from these samples provide valuable supplementary information, but should not be considered as substitutes for undisturbed sampling and tests where these are applicable.

Probings. Very often, after test borings have been made and satisfactory soil samples have been taken, additional vague information concerning the depth to which soft or compressible soil extends can be obtained cheaply by driving a probing rod until resistance indicates that the bearing stratum has been reached.

Whatever the type of machine or sampler used, the most important requirement for the useful application of the test boring is that the borings must be done under the direction of, and the samples must be classified by, a trained soils engineer or technician. The prime purpose for test boring is to obtain samples to develop correct and accurate information.

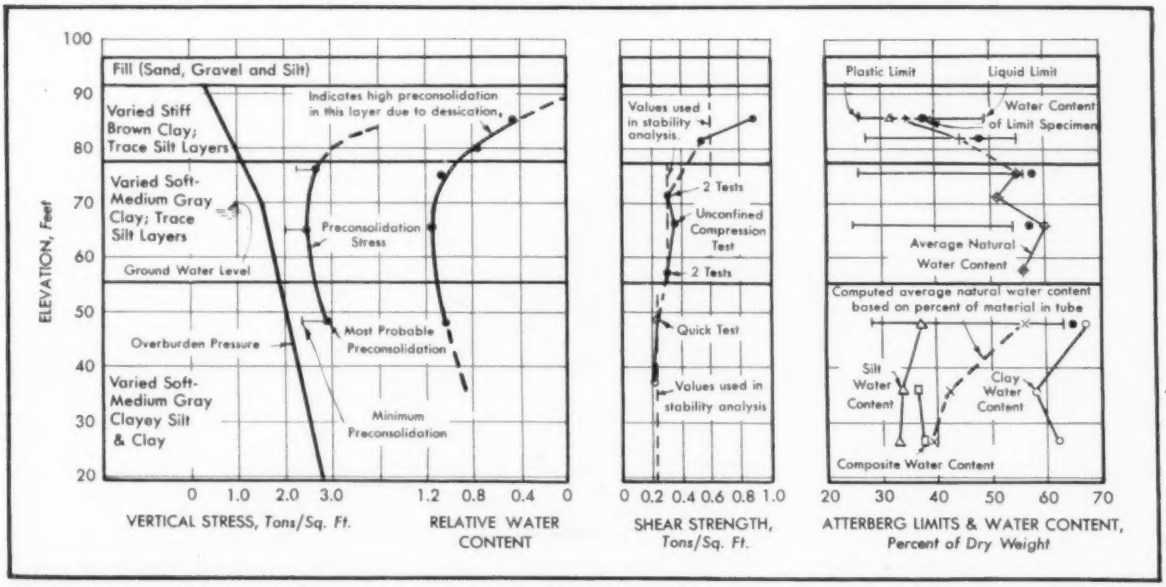
References

1. Undisturbed Sand Sampling Below the Water Table—U. S. Waterways Exp. Sta., Bulletin 35 (1950).
2. Soil Sampler with Metal Foils—W. Kjellman et al., Royal Swedish Geotechnical Institute Proceedings No. 1, 1950.

THE ROLE OF SOILS TESTING

DR. PHILIP C. RUTLEDGE,
Partner,
Moran, Proctor, Mueser & Rutledge, Consulting Engineers

SOIL TESTING is essential in order to utilize to the best advantage the subsoil materials that nature has provided for the support of foundations. However, soil tests and soil test results removed from the context of the geologic origin and complete geologic profile of the subsoils, and from the loads or uses to which the soils will be subjected have little meaning or value.



● **BORING log and soil properties profile are shown for 78-ft. boring. Shear strength is of great importance in soils.**

Soil testing and analysis are intimately connected with design procedures and their value can be utilized only when they are so used.

The results of simple and routine soil classification tests, such as grain size distribution, specific gravity, water content, plasticity limits and compaction characteristics have the same relation to a major foundation problem as simple beam analysis does to suspension bridge design. The problem of soil tests and analyses is complicated by the fact that selection of types of tests and methods is related not only to type and characteristics of the structure but also to subsoil conditions varying with each site.

The preliminary choice of a general type of foundation for a building or bridge is usually made on the basis of soil classifications of exploratory boring soil samples. These, to some extent, are based on the results of routine or classification tests as well as visual examination. When shallow foundations seem possible, the consolidation test, which measures the rate and magnitude of soil volume change under stress, is frequently required to determine whether or not settlements will be excessive for the particular structure. Here one of the less commonly known features of utilization of soil test results appears. The results of the consolidation test do not, in most cases, provide directly the soil properties that can be used for analysis but rather provide a basis for estimating the geologic preconsolidation stress of the soil and for reconstructing the probable stress volume change behavior of the subsoil under the conditions in which it exists in the field.

When any type of deep foundation is indicated, the selection of a suitable bearing stratum in the subsoil becomes of prime importance where strength is a controlling factor because such foundations apply heavy concentrations of load to the bearing stratum. In addition to the routine indentification and classification tests, testing for strength takes the form of simple unconfined compression tests, which are identical in principle to the testing of concrete cylinders; or of triaxial compression tests. The tests encompass a variety of types, sizes, procedures and complexity, but more nearly approaches the actual "in situ" conditions. Selection of the correct type of drainage conditions, preconsolidation, rate of loading and relations between confining stress and axially applied stress is essential to a valid application of the test results. The same consideration of strength testing and analyses for safe bearing capacity apply to all cases of load applied to soil, including shallow as well as deep foundations and earth structures and embankments built above the ground surface.

Ideally, soil tests would be more understandable and of greater value to all engineers if their procedures could be standardized and the application of their results codified. It is this variety of subsoil conditions and the difficulty and cost of obtaining complete and reliable pictures of subsoil stratification and properties that make the experience and judgment of foundation engineers a necessary element in the successful application of soil testing.

ENGINEERING IN CONSTRUCTION CONTROL

J. D. WELCH,
Chief Soils Engineer,
Howard, Needles, Tammen & Bergendoff

THE FUNCTION of construction control is to reproduce the design in the field. Thus, not only is the type of construction control dictated by the design, but the extent of that control is also dictated thereby.

There is an economic balance between the design and cost of construction and the construction control. A design made in an attempt to minimize or circumvent construction control, and still be safe and adequate, would undoubtedly result in increased construction costs, where the increased costs are generally greater than that expended for proper construction control. Similarly, there is a practical limit of economic field control, beyond which no basic improvement of the structure is achieved. The make-up, purpose and function of a structure is dictated by the design and not the construction control.

As examples of construction control related to disturbed soils as construction materials, consider the moisture-density control for compaction of embankments for highways, railroads and airports, or the gradation and classification analysis of select soils to perform a specific function, such as clay blankets or filters for drainage control, or the inplace testing of structural values of soils such as plate bearing or CBR of backfills, or pavement subbase and base courses.

As examples of construction control related to soils in their natural state, consider the correlation of foundation excavation methods and dimensions to anticipated subsurface conditions; or the depth and driving resistance of piles as related to anticipated subsurface conditions; or the load testing of piles with respect to their design considerations.

The degree of construction control is generally in proportion to the size of structure and the degree of soils problems. This may be modified by the economics of the project. It can be appreciated that generally the larger the structure, the greater the construction control necessary. However, many structures of lesser extent may equally require extensive field control as necessitated by the severity of the soil conditions. For instance one may consider the settlement control for embankment foundation stabilization by sand drains, or the underpinning of building foundations by pre-stressed loading on piles, or the moisture-density and material classification control on large compacted earth fill embankments.

● **FILL slide along the Kanawha River in the relocation of Route 61 in W. Va.**

EQUIPMENT FOR SOILS STUDIES

M. D. MORRIS,
Vice President,
TESTlab Corporation

THE HAPPY fact that today a few soils engineers have turned their full time professional efforts and energies to producing the "tools of the trade" for their colleagues has been a big factor in the progress of the field to date. Before, when a research project was planned, the first phase of the work was designing and building the apparatus. Field men had to improvise or not use field pieces. Laboratory people were at the mercy of local and sometimes inept machinists.

Today the picture is brighter in this regard. A research project can devote its entire time to the work per se because good commercial equipment is readily available, as is, or with minor adaptations to suit the individual case. A construction contractor can now bid a job with construction control included in the plan because he knows the cost of the control equipment he needs.

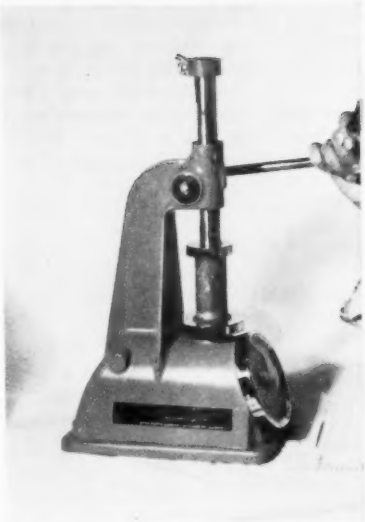
As the result of wide experience gained from observing good and bad features of many existing laboratories, builders of new laboratories get much valuable planning aid from the equipment sales engineer. Better samples are obtained due to the unrelenting efforts resulting from the highly competitive drill-rig sub-industry.

The efforts of the ASTM's soil committee D-18 toward standardization of soil tests are furthered by commercially available equipment. TESTlab Corp., with the cooperation of two colleges, is engaged in a project attempting to establish a single ASTM standard method and equipment set for the liquid limit test.

Men can now see the same apparatus on the job that they saw in college, and a technician can leave one job and go right to work in another laboratory without losing time on indoctrination on strange instruments, in addition to methods. Results of curves from one laboratory and another now have some basis of comparability, and uniformity of results within the same organization are achieved. The overall quality of apparatus has also improved.

Progress, however, must be kept within the bounds of financial and practical limits. For instance, a complete sand cone set can be marketed for about forty dollars, or a liquid balloon device of adequate size for about twice that. Positive advancement has been made, for instance, in consolidation tests. Once, all specimens were dead-loaded on a big scale device. Higher unit load demands caused a change to gross, bulky structural frames, dead-loaded by ponderous weights on lever-hanger systems. Then came the compact precision table-top device that loads smoothly by air pressure, reads accurately, but is totally dependent upon the external factors of electricity and compressed air. The latest development resulting from field use experimentation eliminates the worst features of its predecessors (bulk weight, irregularity, and dependence elsewhere), and combines their best points (precision, compactness, ease of operation, and is self-contained). Such a unit is now commercially available at a reasonable price.

The time, effort, and money of the working soils engineer is free to be concentrated wholly on the work at hand, because now the equipment manufacturing engineer has made it his business to further research and development of newer, more efficient, economical ways to carry on soils studies.



● **SPRING scale type unconfined compression machine used in testing soils.**

SOIL TESTS AND HIGHWAY LOCATION DESIGN AND CONSTRUCTION

TAYLOR D. LEWIS,
Professor and Head
Dept. of Transportation,
Cornell University

THERE ARE numerous areas in which the results of soil testing can aid the highway engineer, but for simplicity the problem will be grouped into five general categories. These are: 1) Route selection; 2) design of subgrade; 3) soil as a material for construction; 4) construction management; and 5) treatment and drainage of soil surfaces.

In considering these five items it might be well to point out that the highway engineer is concerned with the surface soils as contrasted with the deep seated soils which affect the designing of buildings and other large structures. Simply stated, the highway engineer is interested in soils which are 8 to 10 feet from the surface and lie no more than 4 feet below the grade line.

The engineer is concerned with the effect of water in its various forms (water table and free water, capillary water, frost heave and frost action, and water vapor) on soils. He is also interested in the soil profile with its developed horizons. As the horizons are the result of chemical and mechanical weathering and/or transportation of the soil, the profile is a visual indication of soil property differences. If the significance of the profile is realized, the in-place characteristics of the soils as engineering materials are better understood.

In general, sites and locations which are of no value to agriculture are also valueless for highway locations. Soil too poor for agriculture usually makes an inferior subgrade for a highway.

New locations for highways must be economically feasible and a proper investigation of soils and topography will play a large part in the feasibility determinations. Reconstruction on existing rights-of-way would seem at first to be limited simply to design because all the soil factors would be known. However, this is seldom the case. As the design standards for the new highway are invariably much higher than for the existing structure, soil studies for reconstruction are of equal importance to those for new location.

In the design of highways the engineer must have sufficient data

so that he can provide a subgrade design which will be satisfactory under expected traffic loads. The required subgrade performance will be greatly affected by climatic conditions. Subgrade moisture, drainage, pumping, frost, etc., are all intimately connected with the bearing capacity of the subgrade soils. It follows naturally that the soil of a subgrade must be investigated for all conditions of expected climate and load in order that the pavement will not fail due to subgrade failure.

● HYSTER "Grid" roller compacting earth and rock fill on a highway project at Spokane, Wash. Subbase compaction is of prime importance in highway construction.

After the design of a subgrade has been approved it must be transposed into a finished road. This requires construction management. By this is meant selection of equipment and programming of operations to build the road structure. The engineer must know how the soil will "work." For example, density of the soil in place and desired density of soil in embankments must be determined in order that the volume and shrinkage for the soils involved can be computed. The control embankment construction is based on soil density, water content, compaction effort, etc. Compaction, settlement, and subsidence prediction are necessary in order that sufficient material be placed in the embankment.

The selection of equipment for making cuts or fills is, of course, dependent on the nature of the soil encountered. Therefore numerous samples at various depths must be obtained prior to construction in order that such questions as "Is there rock" can be answered. The answer to the question as to the existence of rock is not always sufficient. Various degrees of hardness of rock require various types of excavating equipment. Selection of equipment may also be dependent on the trafficability of the soil to be worked. In some situations treatment of the soil to achieve reasonable flotation must be accomplished prior to the major construction effort. The construction of the designed cross-section is also dependent on the soil characteristics. One question to be answered before construction is on how steep a slope will this soil remain? Also, what are the erosion characteristics of the soil? Good construction management is thus dependent to a large extent on the availability of soil test results. Classification of a soil, as indicated by the test data, into a group makes it easier to predict how it will act and "work." Not only can a soil be classified and its performance predicted but specifications for desired performance can be drawn.

Roads and highways are normally considered to be subdivided into four integral parts; subgrade, subbase, base and surface. Various combinations of load and soil require various combinations of subbase, base and surface knowledge of the local soils will assist in determining the economical combination. In all of these problems, soil test results assist the engineer in his decisions.

In addition, soil tests assist the engineer in proper design of stabilized soils where the local soil needs improvement by additions or by improvement in mechanical gradations.

Drainage from the pavement surface must travel across the shoulders to the ditches and then to a reasonable discharge point. This means that adequate stability and slope must be provided to the shoulders and ditches. Stability and treatment of the soil are, of course, dependent on its ability to withstand erosion. These same things are as true for side slopes as for shoulders and ditches.

In order to reduce maintenance costs it is necessary to design side slopes, ditches, and shoulders, based on the expected performance of the soil. The supposedly simple matter of growing grass as a deterrent to erosion depends on the characteristics of the soil such as the organic content and pH. Seeding and mulching of side slopes, if done without accurate background experience with a particular soil, may frequently be unsuccessful besides leading to an increase in maintenance cost.

CALIFORNIA BEARING RATIO TEST

O. J. PORTER,
Partner,
Porter, Urquhart & Associates

THE CALIFORNIA Bearing Ratio Test is a method for determining the properties of soil and base course materials and their suitability for use in highway and airport construction.

The CBR test is not a "classification" test but measures the shear strength of the soil; and it is, therefore, necessary that the specimen be carefully prepared so as to reproduce as closely as possible the conditions which will be anticipated in the field, and that a test result value is obtained which is related to the bearing value of crusher run base materials as used in the State of California. CBR = (test unit load ÷ standard unit load) × 100. These are the average results of a large number of tests run on such crusher run base course which are arbitrarily assumed to be 100 percent. The ratio of the test results to the standard 100 percent bearing ratio curve is used as a constant for entering empirical design curves which yield the total thickness of pavement and base course required for any given loading. The thickness required to spread the load adequately over the material being tested can thus be determined.

SOILS STUDIES FOR PILES

DR. GIRARD WHEELER,
Vice President,
Giles Drilling Corp.

THE FIRST service that soil studies offer in pile design is the all-important question of probable lengths of the pile selected. Many pile contractors utilize correlation tables which employ the number of hammer blows required to drive an ordinary sample-spoon into the soil during test boring operations. Without deprecating the great benefits of laboratory soil test, it is still a fact that many designers place high value on the contractors' estimates.

Another approach to the question of probable length is by means of direct friction tests, in which the soil is forced under pressure into friction with wood, concrete, steel, etc. With such data, it is possible to estimate the total pile friction and thus its length. Similarly, one can make measurements of the relative density of the soil as it occurs underground, and d velop an estimate of point-resistance during pile driving.

Another objective in soil studies will be to discover (before construction) the resistance of the upper soils surrounding the pile to lateral stress. Measurements can be made in the laboratory of the shearing strength—internal friction and cohesion—of the soil in question. Moreover, by testing the natural strength and the remolded strength of the soil, an idea can be gained concerning how much breakdown of "soil-structure" will occur during pile driving, and whether a mud-wave will be started, with costly consequences. The strength measurements and consolidation tests of the soil will also give insight as to possible displacement and soil-heave behavior. Moreover, the consolidation tests will enable the designer to predict ultimate settlement of the upper soils, with consequent pulling down on the piles after they have been driven.

A third end in view of soil studies will be to examine (and test if necessary) the soils which will ultimately remain beneath the pile points. Will this soil consolidate during the years following construction, and thus cause excess differential settlement? Here again, consolidation tests may yield the best answer.

Fourth will be the question of the effects of future changes of soil conditions beneath or adjacent to the site in question. What will be the effects of a future change of water level in the ground? What will happen to the structure when on adjacent property another structure is erected on piles; or when a ship channel is cut in the nearby harbor mud? Modern soil studies find a place in design where such questions are involved.

Who benefits by the soil studies? It will be readily seen that after properly executed soil studies, the prospective owner or buyer of property can learn in advance whether the property needs pile structures and, if so, their approximate foundation cost. The engineer learns in advance the type of piles which will be best adapted to the structure, without permitting excess settlement or lateral movement, and the approximate length of the piles in question. The builder, by knowing in advance the optimum length of piles which he must use, can avoid waste of excessive "cutoff," and can make a relatively close estimate of costs of driving.

SOILS STUDIES PRIOR TO BRIDGE CONSTRUCTION

TRENT R. DAMES,
Dames & Moore,
Consulting Engineers

NORMALLY, a foundation investigation, regardless of the type of structure, is composed of four basic, interrelated elements: field inspection; laboratory testing: engineering analysis; and interpretation of all the preceding elements in the form of consultations and recommendations. No standard foundation investigation procedures exist which will yield satisfactory results. The relative weight of each element is controlled by both the site conditions and the structural requirements. If the full value of the investigation is to be realized, each basic element should be supervised by a competent soils engineer.

For the construction of bridges, the field investigation is conducted to determine the type and conditions of all soil strata, including rock encountered, water levels, river bottom scour, borrow pit studies and any other feature needed to realize the scope of the investigation. The necessary field information can be obtained normally by drilling test borings at locations chosen by the designer and the consultant, by obtaining undisturbed samples of all strata, by probing and/or by making vane shear tests. The field investigation should be personally conducted by an experienced soils engineer who is fully aware of the designer's problems so that he may report any unusual field conditions that will affect either the design or construction of the bridge. The field work is the key to completing successfully all phases of the investigation. Without clear and accurate logs, and observation by experienced engineers of the site, no amount of testing or interpretation will yield satisfactory recommendations.

As the field information becomes available, the testing program is developed. As there are many laboratory tests which may be performed, only an experienced consultant can choose the proper tests and then interpret and analyze the results. Sometimes, for unusual problems, it is necessary that specially devised tests be developed. As the field and laboratory tests proceed, the engineering analysis starts; all foundation types are considered, and detailed studies are made of all feasible types. The fourth phase begins when tentative recommendations are formed and discussed with the bridge designer; and lastly the final recommendations are presented in report form. Occasionally, in this process, the consultant must return to the site to drill additional borings or to conduct pile or plate load tests to obtain added data.

It is often necessary to perform geologic studies or geophysical surveys so that the soil conditions may be fully evaluated. Usually geologic studies precede the drilling of test borings, while geophysical surveys are performed after drilling a limited number of test holes. Geological surveys are greatly needed to determine the existence of faults in areas subject to earthquake action. Geophysical surveys are of outstanding value in locating firm soil or rock strata. The study of large sites often calls for a preliminary investigation of limited scope. Such a program is often employed in site evaluation and is followed up by a final investigation of enlarged scope.

The following list contains some of the important design needs and construction problems for which the soils engineer, having made proper studies, can provide recommendations: 1) Pile capacities; 2) allowable bearing pressures; 3) allowable

lateral pressures; 4) ultimate and differential settlements; 5) time rate of settlement; 6) downdrag on piles due to settlements; 7) slope stability; 8) active and passive pressure for approaches; 9) deadmen or anchors; 10) large caissons; 11) cofferdams; and 12) compacted fills.

IN PLANNING FOR TUNNELS, USE SOILS STUDIES

OLE SINGSTAD
Singstad & Ballie, Consulting Engineers

PRELIMINARY to the design and construction of a tunnel, a thorough sub-surface investigation is necessary. This should include a compilation of data from the records of geologic surveys, existing tunnels, shafts, mines, excavations, wells and borings which have already been made in the vicinity of the general route of the proposed tunnel. These data, if properly interpreted, may be sufficiently complete and conclusive to be of considerable value in the preliminary design and estimate of cost of the tunnel, but it is usually necessary to make new exploratory borings from the surface as part of the program of subsurface investigations to the end that the permanent tunnel lining may be properly designed; appropriate construction methods analyzed; progress and costs estimated within reasonable limits; and information for prospective bidders on the construction of the work be as complete and accurate as possible.

The frequency and spacing of borings should be such as to provide data for a reasonably correct and detailed development of the portions of the rock floor and the materials of the overburden that affect the design of the tunnel. Rock gorges, faults and crush zones and old stream beds, valleys and canyons, should be thoroughly explored. Where the elevation of the rock floor is a pertinent factor, borings should be carried by diamond drilling for at least 10 feet into the rock, to establish with practical certainty, that the material encountered is bed rock and not a boulder. Diamond drilling should be carried into and below the zone of the tunnel face at suitable intervals.

Where tunnels are built through high mountains at great depth below the surface, it may not be practicable, for physical reasons of inaccessibility and high cost, to drill as many exploratory holes as would be desirable. In such cases, it is very important to have a competent geologist make an interpretation of the proper character of the ground to be penetrated by the tunnel.

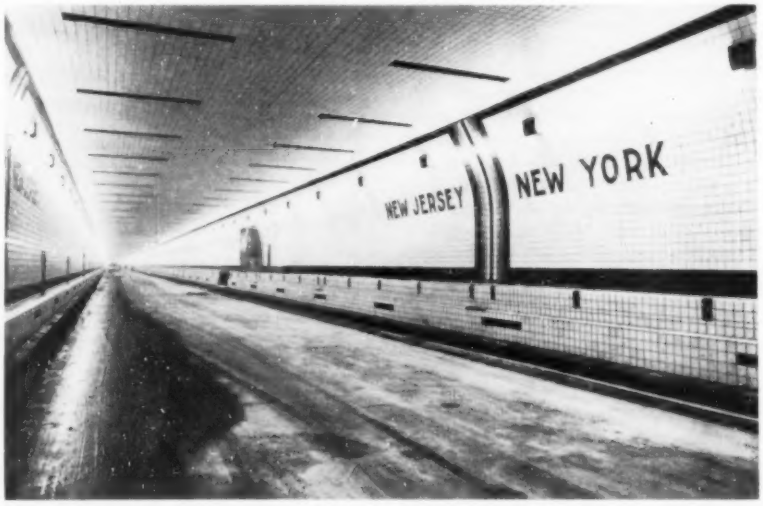
Samples of the materials penetrated by the borings, the overburden and rock, should be taken and preserved for inspection, laboratory testing and study. Sufficient borings and samplings should be made to develop the nature of the different strata of materials overlying and surrounding the tunnel. "Undisturbed" sampling methods should be used to obtain samples of plastic soils and laboratory tests made to establish the properties of the soil pertinent to design of the tunnel and construction methods.

Elevations of ground water and information as to seasonal fluctuations in ground water elevations should be obtained from the borings and other available sources. Possible high hydrostatic heads and artesian conditions should be investigated.

Weight and pressures due to earth, rock and water, cause lateral as well as vertical pressures on the tunnel. The kinds and depths of the materials surrounding and overlying the tunnel must be forecast and also, as well, the physical properties, condition and probable behavior of these materials when the tunnel bore is excavated.

The vertical loads and lateral pressures created by these materials are caused in many cases by gravity alone, but there are other cases where pressures due to physical or chemical changes in the materials when exposed in the tunnel excavation, are also a factor, as in the case of swelling ground and rapidly disintegrating shale when exposed to the atmosphere.

In the special cases of sub-aqueous tunnels built by the trench method, it is important to take borings and soil samples with appropriate laboratory tests and analyses to determine the slope on which the trench will stand up during the period of construction, and to establish the ability of the soil to support the tunnel and appurtenant structures.



● **LINCOLN Tunnel Third Tube used 35,000 cu. yds. of concrete in its building.**

SOIL INVESTIGATIONS FOR EARTH DAM DESIGN AND CONSTRUCTION

W. G. HOLTZ,
Chief, Earth Laboratory Branch, Bureau of Reclamation

IN PLANNING a soils study program for earth dam construction, consideration must be given to a close coordination of exploration, sampling, testing, analyses, design and construction as each of these is closely related. The concerted effort of engineering geologists, design engineers, and materials and testing engineers is required to produce the

most economical and effective investigation program.

The normal development of such information is a progressive procedure which follows a learn-as-you-go pattern. Investigations to develop specifications for earth dam construction can logically be divided into three stages: 1) Reconnaissance, 2) feasibility; and 3) final design and specifications. These may be drawn over a period of years as plans, needs and financing of the project grow; or a rapid development may be in order. Small projects may not require the detail necessary for larger ones.

The data obtained during the reconnaissance stage are formulated into designs and estimates which are used in the initial planning for a study of the engineering and economic possibilities of the project. The main purpose of investigations at this stage, utilizing a minimum amount of data secured in a short period of time, is to compare alternate sites and determine if further investigations are justified.

The foundation investigations during this stage should be directed toward an appraisal of the general subsurface conditions of the site and alternate sites and of available construction materials. Use should be made of geological, agricultural and engineering data from published reports and files of any agencies that have studied the area. A few test holes are sometimes required to clarify the subsurface conditions, and in some instances a few laboratory index tests are made on select representative samples to appraise better the engineeering properties of the soils encountered.

The data obtained during this stage are used for preliminary designs and feasibility (cost) estimates to determine whether a proposed development can be justified from an engineering and economic standpoint. Exploration is planned on the basis of information available from previous work giving due consideration to the location, height, and extent of the major and appurtenant structure and reservoir area. The exploration should be accomplished with the minimum number of test holes that define within broad limits the construction problems likely to be encountered, particularly information that may have a critical bearing on the choice of alternate designs.

Materials investigations at this stage are for the purpose of making an inventory of the potential sources within a reasonable distance of the dam site.

The majority of samples taken for the foundation and materials study are for inspection and classification purposes. It is often necessary to conduct a number of index tests on select samples to firm up certain conclusions on engineering properties and to check field classifications. Structural soil tests are sometimes made on a few samples which are representative of the significant materials encountered. The amount of testing and exploration at this stage must be compatible with the type and size of the dam and the apparent problems that may be encountered.

After the decision has been made to build the structure, additional investigations are required to secure sufficient information for making the final design and for preparing the specifications. This work is to obtain final and detailed foundation and construction materials information, and factual values of soil properties for design purposes. The plan for this more detailed investigation is based on information obtained from the preceding investigations.

The effects of load and hydraulic conditions are normally of extreme importance in earth dams; detailed permeability, consolidation and strength tests must be made. Therefore great care should be exercised in obtaining truly representative, and undisturbed samples for these tests. The thin-wall drive, piston and Denson samplers are most generally used in drill holes, depending on the types of soils encountered. Core samples from 3 to 6-in. diameter or larger hand-cut samples are normally required. Representative materials samples are hand excavated from walls of pits.

The use by field personnel of a well-understood classification system, which describes the engineering characteristic of the soil, is of extreme importance for future interpretation of testhole logs.

SOILS STUDIES FOR THE DESIGN AND CONSTRUCTION OF BUILDINGS

STEPHEN M. OLKO,
Consulting Engineer, New York City,
and
HENRY A. OLKO,
Architectural Designer
Chapman, Evans & Delahanty

THE ARCHITECT and engineer, the team responsible for the design and construction of a new building, is seldom accorded the liberty of selecting the site. The foundation must therefore be site-adapted to the existing soil conditions.

In the past, foundations were designed by rule-of-thumb methods, tempered by the designer's experience. Fortunately, Soil Mechanics has now advanced to the stage where the consulting soils engineer, working with the architect, is able to insure a safe and economical foundation design.

The extent of subsurface investigations is dependent on both the building itself and the soil conditions. The type of structure, such as concrete or steel, its size, the loading, and the intended use of the building—all determine the soil investigation program. For example, a rigid reinforced concrete building cannot accommodate as much differential settlement as a flexible steel structure. Consequently, a more detailed settlement analysis may be needed, requiring undisturbed sample borings and laboratory tests.

The most important soil investigations to be made in conjunction with the design and construction of a building are borings, laboratory tests, plate bearing tests, and pile load tests.

The number of borings and their depth cannot be established by any rule, although some building codes unrealistically state a minimum depth and number per square feet of area. The depth and number of borings required is dependent not only on the area of the building, but also upon the shape of the structure and the loading distribution. One boring, penetrating to a depth of at least 1.5 times the building width, is the absolute minimum where no subsoil data is available.

Tests conducted under laboratory conditions are necessary for both correlation and design. The testing and interpretation of the results should be accomplished by a trained soils engineer.

Plate bearing tests are often utilized to determine allowable bearing capacity. The method of conducting these tests is frequently specified in building codes. The limitations of these tests, however, are sometimes overlooked. It must be realized that a relatively small area is loaded for a very short period, when compared to the actual building foundation.

(*Continued on page* 177)

GRAND RAPIDS MODERNIZES

WATER TREATMENT, PUMPING AND DISTRIBUTION

EDWARD A. SCHEWE,
Associate, J. & G. Daverman Company, Architects and Engineers, Grand Rapids, Michigan

MANY STUDIES were made of the Grand Rapids water system prior to 1955. These studies were devoted almost exclusively to long range supply and did not give adequate consideration to maintaining the existing treating and distribution facilities. However, by 1955 it became apparent to City personnel that immediate measures would be required to keep the water distribution system in satisfactory operation and to provide enough capacity to meet current needs pending the adoption of a long range program.

The first move was a study undertaken by City personnel at the request of the City Commission to check the feasibility and economics of continuing to use power generated at the City's Coldbrook Station for water pumping, general city service, and street lighting. The report made by this study group recommended purchased power. The next move was the preparation of a report by City personnel under the direction of the City Manager, Donald M. Oakes, on the status of the water distribution system with recommendations on the corrective measures to be taken. Later the City Commission engaged William Wallace and Douglas Feben of the Detroit Water Department to study the filtration plant and to submit recommendations for its modernization.

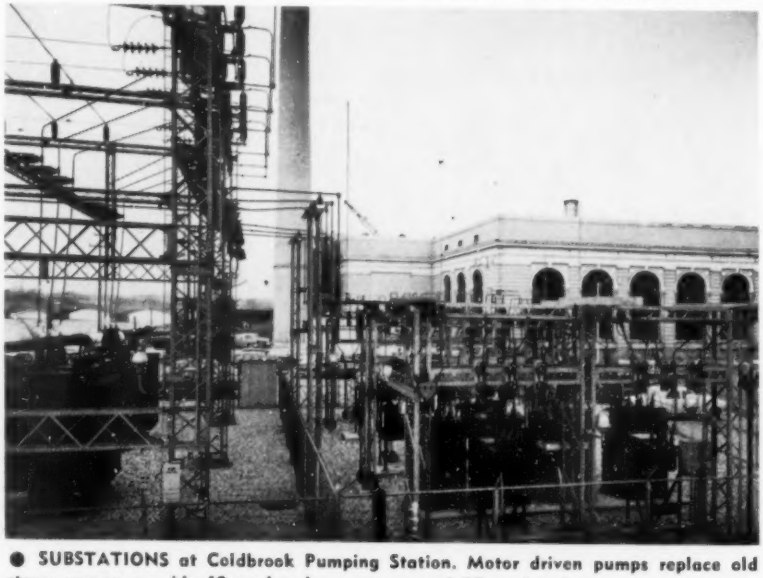
Acting on the three reports submitted, the City Commission directed the City Engineer to undertake the construction of the necessary water mains and water storage facilities required. The Commission also engaged the J. & G. Daverman Company as Consulting Engineers to prepare plans and specifications for, and to supervise the construction of, recommended water pumping, water filtration and electrical facilities. To finance the program the Commission authorized the issuance of $2,000,000 in revenue bonds. This together with funds already available and current earnings, financed the program.

● **ELEVATED tank of 1.25 MG capacity has improved distribution pressures.**

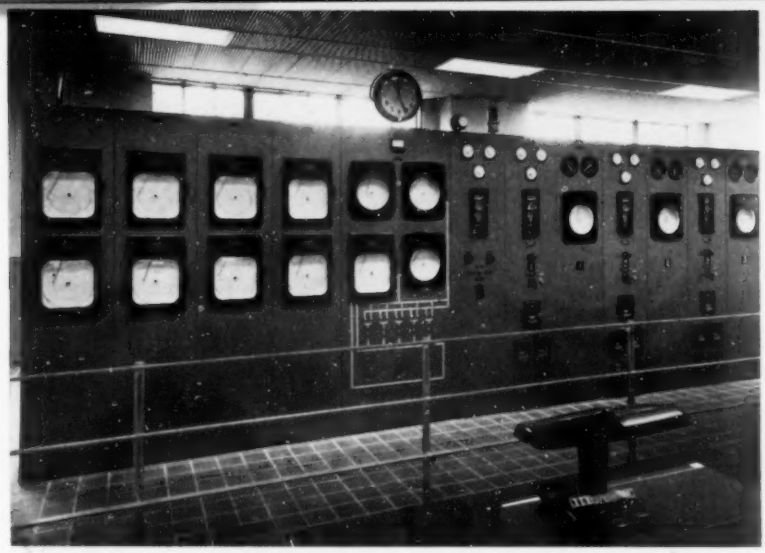
The main supply is from Lake Michigan. Water is pumped from the Lake to the filtration plant at Grand Rapids through a 46-inch pipe line with a peak capacity of 59 mgd. Water is also available from the Grand River, but of poorer quality.

In June, 1955, water filtration facilities consisted of two adjacent plants: the South Plant erected in 1911 and the North Plant erected in 1921. The nominal combined capacity was 44 mgd when treating Lake Michigan water, with somewhat higher capacity permitted during an emergency. The two plants had undergone no major repairs or modernization prior to this program. Chemical mixing was accomplished by means of long, baffled chambers; the settling basins were also baffled; the head loss through the plants, inherent in their original design, limited the amount of water that could be processed.

Coldbrook Station, the main pumping station, was supplied with water from the filtration plant clear-



● **SUBSTATIONS at Coldbrook Pumping Station. Motor driven pumps replace old steam pumps, provide 40 mgd to low pressure and 35 mgd to high pressure systems.**



● **CONTROL panels at Coldbrook. Reservoir and elevated tank level recorders, left; pump controls and flow gauges, right. Note mimic piping with indicating lights.**

wells through two gravity conduits, one 48-inch and one 60-inch, each about 3,000 feet long and terminating in a common surge and suction well at the station.

Both low pressure and high pressure systems were controlled from Coldbrook Station. The low pressure system supplied water to the lower areas of the City and to three underground storage reservoirs, with a combined capacity of 40 million gallons, located on high ground. Two of these were equipped with booster pumps to feed the high pressure system, but the pumps were of inadequate capacity for the pressure required. The third reservoir merely floated on the low pressure system.

Several booster stations were in use, in addition to those at reservoirs, taking suction directly from the low pressure system and supplying the high pressure system. The northwest area of the City was the only area with adequate elevated storage. High pressure system storage in the northeast and southeast sections of the City consisted of ground storage tanks which were too low to provide both reserve storage and adequate pressures in those areas.

Some areas were water starved during the high-use months to the extent that the fire department placed loaded tank wagons at strategic locations for emergency use.

The pumping equipment at Coldbrook Station, long neglected, consisted of two vertical pumping engines installed in 1911 and 1914 and three steam turbine driven pumps installed from 1925 to 1930. Pumping capacity was inadequate, and maintenance was high. Ruptured pump piping had already threatened disaster. Steam generating equipment at Coldbrook Station ranged in age from 5 to 33 years and for the most part was expensive to operate and maintain.

Generating equipment supplying electric power for Coldbrook Pumping Stations and the City street lighting system consisted of four steam turbine driven, 2400-volt, two-phase generators ranging in capacity from 300 to 1500 kilowatts. The oldest generator had been installed in 1910, the newest in 1927. The equipment was obsolete, and the cost of power generation was high.

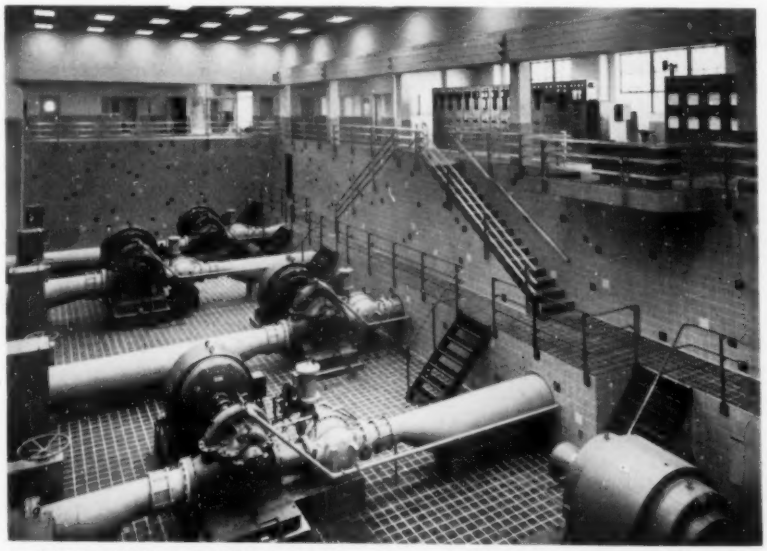
Modernization Program

Under this program no steps were taken to augment the water supply as the program was essentially one of improving existing water filtration, water distribution and electric power facilities. At the present time the City of Grand Rapids is considering various means of obtaining additional water, ranging from another pipe line from Lake Michigan to further use of Grand River water in conjunction with the existing lake pipe line.

Since either of the two plants which comprise the Grand Rapids Filtration Plant was able to handle the existing water demand during the late fall, winter and early spring months it was possible to supply water demand with one plant during the modernization of the other plant.

Work on the South Plant was begun first. All of the baffles in the mixing and grit basins were removed and the basins converted into two parallel flocculation basins. Stuart walking beam equipment was installed for flocculation. Since this equipment is top entering and the original basins were covered with concrete roofs, it was ideal for this project. At the feed end of the flocculation basins four rapid mix chambers were built and equipped with top entering mixers. The discharge ends of the flocculation basins were equipped with a series of sluice gates to regulate water level. The installation of two parallel flocculation basins, rather than a single basin, was made to permit making any necessary repairs to one half with the other half in operation. The rapid mix chambers can also be isolated for maintenance.

Two existing, baffled settling basins were converted into a single basin and all baffles were removed. Both the feed and discharge ends of



● **PUMP ROOM at Coldbrook Station. Water reaching plant is under low head, so all new pumps were set at basement level. Five pumps deliver 75 million gals. a day.**

the settling basin were equipped with a series of sluice gates for level control. A new flume was constructed across the discharge end of the flocculation basins over to and across the feed end of the settling basin to convey the flocculated water to settling. It was possible to use existing water passages, with minor alterations, to convey the settled water to the existing filters.

As soon as work on the South Plant was completed and the plant run through the necessary performance tests, it was placed in operation. Work on the North Plant was then begun. The modernization of the North Plant was essentially the same as for the South Plant. Except for some dimension differences, etc., the two plants are mirror images of each other.

The existing chemical feed equipment for both plants, with the exception of chlorinators and sulfur dioxide feeders, was retained in service. Completely new chlorine and sulfur dioxide handling, storage and feeding systems were installed. An existing sluice gate control house, which was no longer required, was converted into a chlorine and sulfur dioxide storage and weigh room with additional outside cylinder storage, electrified overhead trolley and other necessary equipment being provided. A chlorine feed room was built in the North Plant head house and was equipped with six new Wallace and Tiernan chlorinators and two sulfur dioxide feeders. Chlorination facilities were provided for both pre- and post-chlorination. A series of distribution headers permits using any of the six chlorinators for any of the feed points.

As a part of the modernization program, some of the existing filter bottoms were replaced. Also, rapid surface wash equipment was placed in some of the filters. This work is continuing and is being carried out by City personnel as a part of the maintenance program.

The modernization of the filtration facilities was highly successful and resulted in: 1) An increase in nominal capacity from 44 to 66 mgd; 2) greatly reduced head loss through the plant; and 3) a big reduction in chlorine cylinder handling labor.

Distribution

In order to provide adequate water pressures in the high areas of the City which were water starved, three new high pressure districts were created, one for the northeast area and one for the southeast area of the City. The northwest area was already a pressure district, in a sense, at least, and the southwest area was being handled adequately by the existing high pressure system with the help of a booster station fed from the low pressure system. The new high pressure districts are not completely isolated from the old high pressure system, but are interconnected with it at various points to bolster pressures in other areas.

To serve the new northeast, high pressure district the 16-mg Livingston Reservoir, formerly floating on the low pressure system, was equipped with three new Wheeler-Economy pumps which now supply water to the area through a new 30-inch booster main. A new 1.25-mg elevated tank was installed to equalize pressures in the area. Two of the pumps installed have a capacity of 5 mgd each, and one has a capacity of 3 mgd in order to handle adequately fluctuations in demand.

To serve the new east pressure district an abandoned booster station was put back in service with the installation of three new Wheeler-Economy pumps of 0.75, 1.0 and 1.5 mgd. These pumps take suction from the low pressure system. Since this pressure district is not large, no elevated tank was provided, but new booster mains were laid into the area.

In the new southeast pressure district, the existing, low head pumps at the 16-mg Franklin Reservoir were replaced with high head units of greater capacity. Pumps installed were a 14-mgd Worthington vertical pump removed earlier from the Lake Michigan Station in a capacity change; and two new Worthington vertical centrifugals, 6 and 10 mgd capacity. The installation of new feeder mains and a new 1.25-mg elevated tank completed the project.

Pumping Station Changes

The main pumping station, Coldbrook, was completely rebuilt hydraulically and electrically. Four existing steam driven pumps were removed and replaced with four Worthington 25-mgd and one Worthington 10-mgd electric motor driven centrifugal pumps. Pump motors and field application panels were furnished by the Electric Machinery Manufacturing Company. The five pumps, when operating in parallel, have a total capacity of 75 mgd, 40 mgd to the low pressure system and 35 mgd to the high pressure system.

● **FLOCCULATION and settling basins at North Plant, showing walking beam equipment during construction phase. Other changes are described in accompanying text.**

In order to provide the best possible suction conditions for the new pumps, since the water from the filtration plant is under very low head when it reaches Coldbrook Station, all new pumps were set at basement level. Also a new, 60-inch sectionalized loop header was installed, connecting the existing 48 and 60-in. conduits which bring water to the station. The existing suction well in the station yard has been abandoned. The loop header is so valved as to permit maintenance to be carried out on one-half of the supply system with the other half in service. All main header valves are motor operated to insure rapid closing in case of trouble.

All pumps discharge into existing 48-in. high and low pressure mains

in a pipe gallery outside the station. A cone by-pass valve, controlled electrically from the station floor, was installed between the two 48-in. mains to provide close control of the flow into the two pressure systems.

Because of the serious water hammer which could develop, were station power to be interrupted, separate surge relief systems were installed to protect the supply header and conduits and the pump discharge lines and mains. The surge relief valves discharge into 30-in. headers which will convey the water to an existing basin outside the station and thence to the river, should surge conditions prevail.

Each new pump is equipped with an S. Morgan Smith cone check valve. These valves are oil operated, using an accumulator system, and have two closing speeds, normal for ordinary shutdown and fast closing on power failure.

Instruments have been provided to record water pressures, the output of each pump and the total station flow. Coldbrook Station has been set up as the nerve center of the Grand Rapids water system. All operations are controlled from this station. Contact with the Lake Michigan Pumping Station is maintained by radio; and with the filtration plant by radio and by leased wire. Through the new supervisory control system installed as a part of the program, all pumps in all booster stations throughout the City can be started and stopped from Coldbrook Station. In addition, instruments at the station record the water flow and pressure at each booster station, and the water level in each reservoir, each elevated tank and the filtration plant clearwell. Westinghouse supervisory control equipment was used. Recorders, gauges, and transmitters were furnished by the Foxboro Company and the Bristol Company.

A number of precautionary measures have been taken in the rebuilding of the station to guard against flooding of the pump floor. The walls which surround the pump floor are of poured concrete and the area is accessible from the basement only through two water tight doors. All major water piping within the station is steel to minimize the danger of flooding due to a line break. An existing 25-foot diameter cooling water basin in the basement was blocked off from its river connection and converted into a pumping basin for two Peerless 5,000-gpm and one Peerless 100-gpm sump pumps. The small pump takes care of normal drainage and the two large pumps would come into play should a large flood of water enter the basement, either from a line break or from the outside.

To provide outside air to the pump room for motor heat removal during the summer months, two 5 x 6-ft. inlet air grilles were placed in the north pump room wall at floor level. These grilles connect to vertical concrete ducts and thence through steel ductwork to a 43,700 cfm American Blower fan. Air is exhausted from the pump room thru ceiling grilles connected by ductwork to an exhaust fan of the same make and capacity.

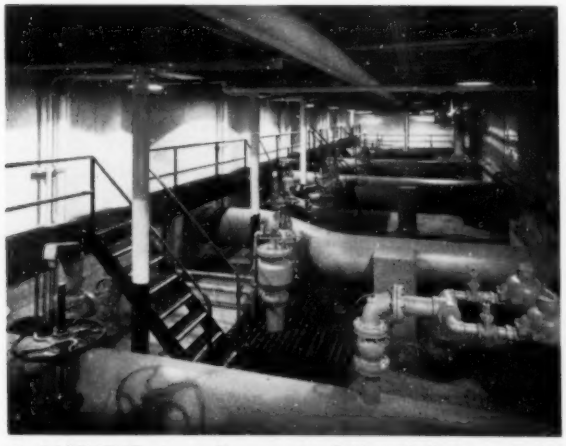
In rebuilding Coldbrook Station it was possible to lower the pump room ceiling, thus providing a large overhead area for future use by the City for other purposes. This move a'so greatly reduced the winter heat load.

Quarry tile was used on the operating and pump room floors for long life and low maintenance. The pump room walls were covered with gray ceramic tile. Blue, brown and yellow tile were inserted at ramdom to add life to the gray wall. One of the architectural features is a tile mural on the north wall of the pump room depicting the Grand Rapids water system. The ceilings are U. S. Gypsum "Corrutone" perforated metal acoustical tile backed with mineral fibre pads.

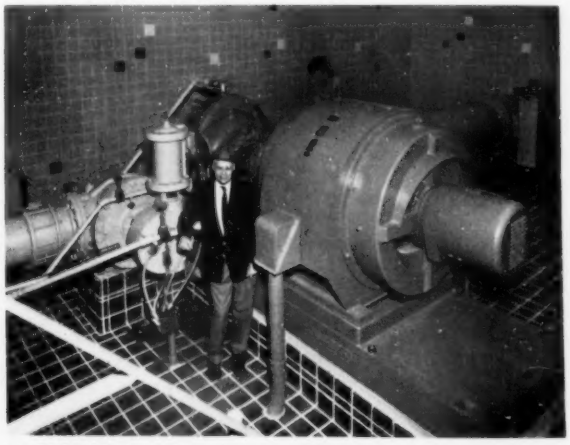
The work of carrying out the hydraulic modernization of Coldbrook Station was done in two phases. Phase One was begun in October, 1956, as soon as water demand fell to a point at which some of the existing pumps could be released from service. The old Allis-Chalmers vertical pumping engines were removed first, and new electric motor driven pumps were installed in their stead, together with the necessary valves and piping, including most of the new 60-inch supply header. During this period, the existing turbine driven pumps supplied the city with water.

By May, 1957, sufficient new pumping capacity and piping had been installed and tested to permit this portion of the new pumping system to handle the water demand. Phase Two was then begun. It consisted of removing two turbine driven pumps and installing the last new electric motor driven pump.

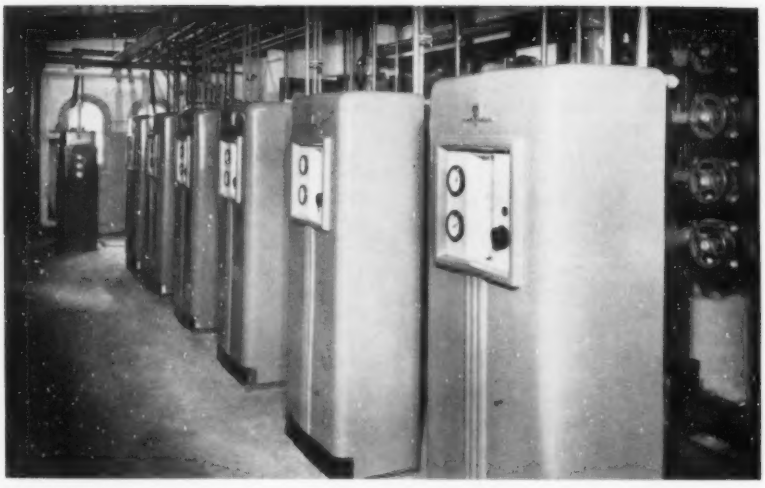
It is worthy of note that although Coldbrook Station was completely rebuilt hydraulically and major changes were made out in the system, uninterrupted water service and pressure were maintained throughout. The distribution system modernization provided: 1) A completely modern main pumping station; 2) reduced main pumping station pressures resulting in lower water main maintenance; 3) greatly



● **BASEMENT pipe gallery at the Coldbrook Station showing pump discharge piping, surge relief valves and other controls.**



● **ONE OF the 25 mgd pumps. Shown alongside of it is the Superintendent of the Dep't. of Water and Light, Spencer Ferris.**



● **SAFETY of the water delivered to consumers is assured by these six new chlorinators any of which will feed to any point, providing both pre and post-chlorination.**

reduced main pumping station operating and maintenance costs; 4) good water pressure and volume in elevated areas of the city; 5) greater pumping capacity; and 6) better control of water pressures throughout the City.

Electric Power

Power for the operation of the filtration plant, formerly supplied by generators at the Coldbrook Station, is now supplied by Consumers Power Company through a new enclosed substation at the filtration plant. Two sources of power were provided by Consumers Power Company to minimize the possibility of an extended power outage.

At Coldbrook Pumping Station, a new 2400-volt outdoor substation was constructed by the City, in conjunction with one erected by Consumers Power Company, to supply the bulk of City power requirements. The substation contains the switch gear which starts and stops the pump motors. It also includes a 1500-KVA transformer bank and oil circuit breakers, with controls, to feed the City's 7200-volt distribution lines. General Electric switch-gear was used.

Power is supplied to the Consumers Power Company substation from a 44-KV loop. Power is fed from the City's outdoor substation to the pumps and distribution switchboard by lead covered cable run underground in encased fiber ducts from the substation to the pumping station. Cable and control wiring within the station are run in cable troughs suspended from the floor structure.

New electric control panels were installed within the station for pump controls. These panels contain the hydraulic gauges and recorders for pumping control. They also contain the equipment required to provide automatic pump starting, which is one of the features of the plant. To place a pump in service, the operator merely turns one handle on the control board, after which all the necessary functions are automatically performed in proper sequence and in proper time by means of electrical relays and timers, with a reverse cycle going into effect on pump shutdown.

The obsolete and overloaded open type switchgear and switchboards which formerly controlled the City distribution lines were replaced with metal clad drawout switchgear having 5,000-kilowatt capacity.

Substations and Switchgear

New substations and switchgear were installed at all booster stations to permit operation directly from Consumers Power Company distribution lines. The switchgear at each booster station consists of metal clad, drawout air circuit breakers with controls wired for automatic operation. Control wiring is so arranged that the starting and stopping of pumps is initiated by the operation of a single switch with all necessary safety and alarm devices installed for remotely controlling the booster stations by the Coldbrook Station operator.

In modernizing its electric power facilities, the City gained: 1) A much lower electric power cost; 2) modern electrical facilities which provide greater safety and expanded capacity; 3) lower maintenance costs; and 4) a large saving in manpower due to automatic control of all routine operations.

CONTRACTORS AND EQUIPMENT MANUFACTURERS

Contractors

Barnes Construction Company

Canonie Construction Company

Clement Electric Company

George Datema & Sons, Inc.

Grand Rapids Industrial Electric Co.

Holwerda Huizenga Company

Kirkhof Electric Company

Leitett Iron Works

Phoenix Sprinkler & Heating Co.

Vander Waals-Troske Company

Equipment Manufacturers

American Blower Company:
Blowers

Armco Drainage & Metal Products, Inc.:
Sluice Gates

The Bristol Company:
Instrumentation

General Electric Company:
Switchgear

Dresser Manufacturing Division:
Couplings

Electric Machinery Manufacturing Company:
Pump Motors

The Foxboro Company:
Instrumentation

Golden Anderson Valve Specialty Company:
Surge Valves

The Lock Joint Pipe Company:
Concrete Pipe

Mixing Equipment Company, Inc.:
Rapid Mix Equipment

Peerless Pump Division:
Sump Pumps

The A. P. Smith Manufacturing Co.:
Gates Valves

S. Morgan Smith Company:
Cone and Butterfly Valves

Stuart Corporation:
Flocculation Equipment

Wallace & Tiernan:
Chlorinators

Westinghouse Electric Company:
Supervisory Controls

Economy Pump Division, C. H. Wheeler Manufacturing Co.:
Booster Pumps

Worthington Corporation:
Coldbrook Station Pumps
Booster Pumps

● **RESURFACING PROGRAMS** are greatly facilitated by the use of portable hot-mix plants such as the Barber-Greene plant pictured in this photo sent to us by Milton R. Handel, Highway Superintendent of Hutchinson County, Olivet, South Dakota.

MOST USEFUL EQUIPMENT FOR COUNTY HIGHWAY DEPARTMENTS

ON THE questionnaire sent to county engineers and county highway superintendents throughout the United States, in 1957, the question was asked "What is your most useful equipment?" The Editors have compiled some of the data that was returned on the questionnaires.

R. C. Word, Calhoun County Engineer, Anniston, Ala., stated that a truck mounted dragline with timber hooks and three part hoist line was used to clear right-of-way for new construction and was his most useful piece of equipment. On a job for relocating and rebuilding a present road the rubber tired machine was used to cut and pile all timber except very large stumps during wet winter weather. Men are on monthly payroll whether they are actively working or not and this is good utilization of resources that would otherwise be idle. The same idea was used to some extent on clearing right-of-way on existing roadways especially around bridges.

"An Ottawa hydraulic backhoe on a Cat. D-4 tractor used for adjusting water, gas and sewers and ditching for approximately 2½ mi. of storm sewer on a street paving project in the City of Selma, proved to be my most useful piece of equipment. It is ideal for work under low clearance power and telephone lines and in very cramped space." This comes from Lewis J. Moore, Jr., Dallas County Engineer, Selma, Ala.

Francis C. Smigle, the Napa County Deputy Engineer, Napa, Calif., uses Michigan truck-mounted shovels for bank sloping, culvert installation, channel clearance, ditch cleaning and for slide removal. Also a Caterpillar tractor and a Carryall used in earthwork moving and ditch construction were useful along with a Tampo roller used in compacting subgrade and bases and rolling seal coat surfaces.

A portable crusher that has been used all over the county enabling us to provide cheap crushed rock base courses and road-mix and hot-mix aggregate according to R. C. Downer, El Dorado County Road Commissioner, Placerville, Calif., is his most useful piece of equipment.

J. W. Oxford, Jr., Spalding County Engineer, Griffin, Ga., says motor graders for maintenance and new construction, tractors and scrapers for grading operation, cranes for pile driving and bridge construction and a portable rock crusher for maintenance work were his most useful equipment.

Perry Barber, McDonough County Engineer, Macomb, Ill., used a Seaman self-propelled tiller and motor patrol, and an Athey loader regrading roads. The Seaman tiller was used to break up the sod and "saved us days of working the sod over on the road."

M. E. Clark, Kendall County Supt. of Hwys., Yorkville, Ill., says a Caterpillar motor grader D12 was very useful in medium to heavy ditching and grading.

Ivan J. Troyer, Supvr., Noble County, Albion, Ind., says "a Universal gravel plant or crusher used to prepare crushed gravel for roads was one of my most useful pieces of equipment."

Arthur F. Buerkle, Tippecanoe County Surveyor, Lafayette, Ind., says his dragline has been doing wonderful work on side ditch cleanout and getting proper drainage.

Fern M. Cooper, Fountain County Hwy. Supvr., Mellott, Ind., states "we have our own power shovel and we use it almost exclusively in the county. We maintain gravel pits for loading and stripping and this gives us ample opportunity to move about the county and divide our work more evenly among the 11 townships. We also use our large motor graders to turn and mix cutback black top very effectively."

Chas. E. Condra, Floyd County Engineer, New Albany, Ind., says a power grader and front end loader cleaning ditches and power graders in maintaining aggregate surface roads are his most useful equipment.

William C. Stone, Monroe County Engineer, Albia, Iowa, likes his crawler mounted front end loader. "I use this machine for cleaning ditches, laying pipe, loading material and many odd jobs."

W. G. Harrington, Scott County Engineer, Davenport, Iowa, says "our best deal turned out to be our Gradall and we are buying our second one. We lay 50 to 60 percent of our culverts with it; we can work it in 'tight' places, as far as overhead obstructions are concerned; we clean out culvert ends; shape up spot shoulder erosions; remove, clean and relay existing culverts; clean many miles of ditches; make channel changes of smaller sizes; load from stockpiles occasionally; do some small clearing and grub-

bing work—especially where we can't blast; and numerous miscellaneous jobs."

A Seaman-Gunnison self-propelled rubber and steel wheel roller for preparing base and subbase for stabilization and bituminous pavements is reported as the most useful piece of equipment by Charles K. Paulson, Hancock County Engineer, Garner, Iowa.

C. A. Spaethe, County Engineer, Delaware, Iowa, uses a TD9 with a Drott clam bucket in clearing and grubbing. This machine is used summer and winter to pile brush, load stumps, rock and boulders.

Ralph Greenwood, retired Fremont County Engineer, Tabor, Iowa, says the most useful piece of equipment he used was the two-way radio "because it saves time and keeps equipment in action. The shop is equipped, also the Engineer's car and 3 shop pickups. The oiler trucks are so equipped that we are able to catch almost anyone anywhere, and many times the mechanic is within a few miles, and can get the equipment repaired in a short time. Also, there are no fuel delays in case some one runs short; and the low-boy can be reached wherever he is and many times can move needed machinery on short notice."

M. Y. Kinne, Hamilton County Engineer, Webster City, Ia., believes his shoulder widening machine used for placing rock on pavement shoulders has been his most useful piece of equipment.

Frank B. Reeves, County Engineer, Brown, Kansas, likes his Athey Loader with portable crusher for crushing oversize gravel.

Ralph E. Campbell, Brown County Engineer, Hiawatha, Kans., uses the Domor elevating grader to load trucks in gravel pit and says it is his most versatile piece of equipment.

A. W. Young, Allen County Engineer, Iola, Kans., says "our portable rock crusher was our most useful piece of equipment the past year. The crusher was used in crushing limestone which was used for County road resurfacing."

H. C. Antrim, Wyandotte County Engineer, Kansas City, Kansas, says an Athey loader was used very effectively to load dirt and trash from the roadway onto trucks after it had been bladed from the roadway.

Malcolm M. Steele, Johnson County Engineer, Olathe, Kans., says a Caterpillar No. 112 with a Domor elevator for ditching is a fine unit and is his most useful machine.

E. L. Walker, Pottawatomie County Engineer, Westmoreland Kans., uses a self-propelled rock crusher that picks up coarse gravel from windrows and crushes to the proper size and at the same time helps mix and blend the materials for the surfacing of the road. This permits the use of local material, reducing the cost of some jobs as much as 50 percent.

Earl F. Rogers, Huron County Engineer, Bad Axe, Mich., uses a Cedar Rapids crusher, Junior Tandem, and says it is his most useful piece of equipment." By continuous use, the crusher has allowed us to make gravel production the most efficient operation of the entire organization relative to private and competitive costs."

Thomas A. Webb, Engineer Manager, St. Joseph County, Centreville, Mich., says his most versatile pieces of equipment are their 75A Michigan front end loaders.

Wayne B. Welch, Supt.-Manager, Otsego County, Gaylord, Mich., says the Gradall is great for ditching and rock laying.

Martin B. Platt, Supt., Manistee County, Manistee, Mich., uses a D-7 Caterpillar and power graders in grade construction. He also does tree removal with a bulldozer blade.

Ervie W. Prenevost, Yellow Medicine County Highway Engineer, Granite Falls, Minn., says the most versatile machines were motor graders used for maintenance, backsloping and ditching.

Norman Schmidt, Todd County Engineer, Long Prairie, Minn., listed motor graders on road work and snow plowing as his most useful equipment.

Ray C. Deegan, Blue Earth County Highway Engineer, Mankato, Minn., says "our Link Belt shovel is one of the best pieces of equipment we have."

Joseph Seidel, Pennington County Highway Engineer, Thief River Falls, Minn., says "our motor graders are the best and are used for summer maintenance, winter snow-removal and in addition when time permits regrading roads, pulling in shoulders and grading or building private driveways.

J. S. Wagnild, Cottonwood County Highway Engineer, Windom, Minn., has a Bros self-propelled pneumatic tired roller that is especially useful in bituminous and base-construction. This machine also works out very well for bituminous sealing to roll in the aggregate immediately following the chip or aggregate spreader with no turning around necessary.

Gordon M. Fay, Winona County Highway Engineer, Winona, Minn., has a 1600-gal. water tank and pump that is used to apply liquid calcium chloride to stabilize base and to control roadside weeds. This, he believes, is his most useful piece of equipment.

G. B. Beard, Scott County Engineer & Supt., Forest, Miss., says "our most effective work is done by two 10-cy AC motor scrapers, 2 bulldozers, and 2 motor graders, which make up a countrywide grading crew. We built 14 miles of completely new roadway, moving around 300,000 cu. yds. of dirt."

Daniel K. Kelly, Leflore County Engineer, Greenwood, Miss., has tried out a new system of stabilized base using a Seaman mixer "which we think will give us a satisfactory base and pavement suited to our very unstable soil and also is inexpensive. The unit put down 10 miles per year and we think it is our most versatile piece of equipment."

P. I. Turner, Noxubee County Engineer, West Point, Miss., says "we used the Etnyre distributor, our motor grader and aggregate spreaders most effectively in placing double bituminous surface treatment on roads which we had previously placed base courses.

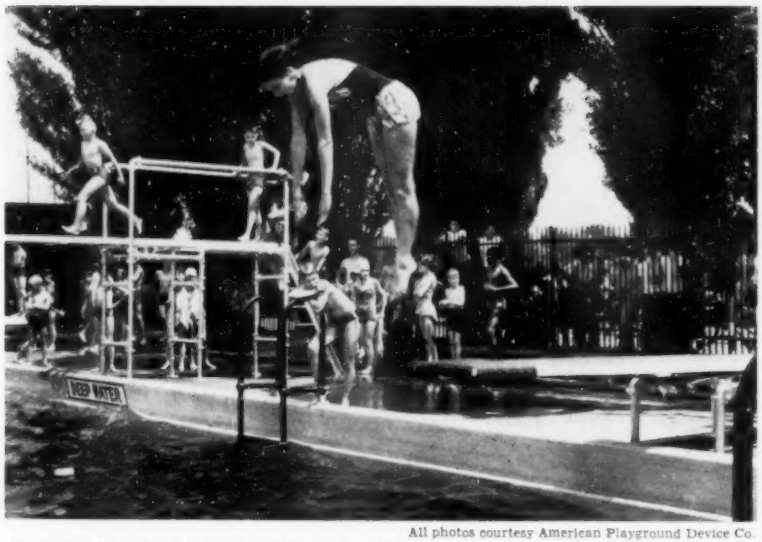
F. E. Ross, Cole County Highway Engineer, Jefferson City, Mo., has an Allis-Chalmers TL-10 high lift "which we use for loading dirt, gravel and rock into trucks. Last winter we had several men cutting brush and trees along the county roads and used the TL-10 to make large brush piles to be burned. This was our most useful machine."

"Since I became highway engineer, in the spring of 1951, we purchased a Pioneer gravel rig" says Clair V. Mann, Phelps County Surveyor and Highway Engineer, Rolla, Mo. "It helped do a world of good

(*Continued on page* 157)

● **CATERPILLAR motor grader with a Domor elevating grader attachment builds 35 miles of road each year for Seward County, Nebraska. Photo was sent to us by County Commr. Ed Noler.**

Have Fun with Safety



All photos courtesy American Playground Device Co.

● SWIMMING pool, 75 by 300 ft., has pleased Niagara Falls children since WPA.

IS NIAGARA FALLS SLOGAN

WILLIAM J. DUCHAINE
American Playground Device Co., Anderson, Indiana

FUN AND SAFETY are combined in a year-round supervised recreation program in Niagara Falls, New York. In this city of 102,000 population, the municipal recreation department reports more than a million attendance at its various activities.

The busiest season, of course, is the summer, which starts with the distribution of an 8-page bulletin, "Let's Have Fun," to all the homes in the city. More than a dozen youth organizations and other civic groups sponsor various recreational programs, with the cooperation of the municipal recreation department, headed by Director Myron N. Hendrick. These activities run the gamut of swinging, sliding and see-sawing on the playground to day camps, swimming, baseball, lawn bowling, soccer, tennis, dancing and golf.

Always the accent is on safety. When Director Hendrick hires about sixty young college people for the summer vacation period, he loses no time in their indoctrination on the prevention of accidents. A daily routine is followed in the promotion of safety. Swings, slides and other playground apparatus are inspected every morning and afternoon. Defective units are withdrawn from use immediately and the supervisor notified as to the defects.

When an accident occurs, the playground leader promptly determines the nature and extent of injury, gives first aid, and makes out a complete accident report. In cases of serious injury, the leaders are instructed not to move the patient, but call the nearest doctor, and apply emergency first aid until the physician's arrival.

"Early morning and afternoon apparatus inspection and playground cleaning are the first steps in the prevention of accidents," says Director Hendrick. "Secondly, enforcement of rules for the safe use of apparatus, plus alert supervision, results in a sharp decline in accident rates."

Director Hendrick says Niagara Falls has 27 playground apparatus areas in various sections of the city. Among these, the most accidents occur on or near swings. Swings always get a big play and there usually are children waiting nearby for their turn. Mr. Hendrick advises his leaders to prevent the following dangerous practices on swings: Pushing of unoccuppied swings; more than one child on a swing; twisting and swinging sideways; running, chasing and playing between or around swings; running under swings; standing on swings; swinging too high; throwing swings over frames in order to make them shorter; and swinging children facing in different directions.

Under Mr. Hendrick's direction, all playground apparatus areas have been equipped with American all-steel slides, which obviate the possibility of children being injured by wooden splinters and slivers. However, accidents can happen if the ordinary rules of safety are not observed. Here are some hazardous practices to be avoided: Waxing slides with waxed paper; standing up on slides; putting babies on slides; forcing anyone to slide or pushing person at the top of the stairway; coming down backward; and climbing up slide.

Playground leaders teach the children not to jump off see-saws without care for the partner, and not to stand or walk on the boards. Chil-

● ALL-STEEL slide installed at the Hyde Park playground, Niagara Falls, N. Y., needs very little maintenance.

FITCHBURG CHIPPER

"OPERATES 1693 HOURS without a breakdown of any kind!"

WELDON S. CAMPBELL
64 MUNSON STREET
GREENFIELD, MASSACHUSETTS

February 4, 1958

Fitchburg Engineering Corporation
Fitchburg, Mass.
Mr. Perini, Superintendent

Dear Sir:

On March 23, 1955, we purchased one of your Chippers. You may be interested to know that this machine operated a total of 1,693 hours without a breakdown of any kind. Inasmuch as we are paid for running time only we often start up the chipper 20 or more times daily.

We have followed faithfully your instructions in using a hone on the knives each morning, we find that by doing this we can use the knives for five weeks before sharpening. Even then only about 12 thousands are needed to bring them back.

Contractors find your chipper is ideal and saves them much time and dollars in clearing a woodland area before bull dozing begins.

Your Engineering skill and knowhow has resulted in the finest of all Chippers and I have seen them all in operation.

Hauling time is reduced two-thirds, this results in a large saving in gasoline, parts and labor. I would never again be without one.

Respectfully,
Weldon S. Campbell
Weldon S. Campbell
Tree Warden & Moth Supt.
Greenfield, Mass.

Fitchburg Wood Chippers are engineered to stand hard use, to give long service without excessive maintenance costs.

That's the "reason why" successful men like Weldon Campbell prefer Fitchburg for the tough brush removal jobs.

Fitchburg Chippers are designed by engineers for busy, trouble-free service. The exclusive spring-activated feed plate adjusts itself automatically—provides protection from damaging foreign material—assures smooth, efficient operation. The power take-off clutch gives safe starts and stops. There's no fly wheel to cause bearing trouble. These features keep a Fitchburg Chipper on the job . . . save you time and money.

Send for a copy of "Chip Dollars From Your Overhead."

NEW FREE BOOK
"Chip Dollars From Your Overhead"
Complete with cutaway color drawings of Chipper in action. Specifications, etc.

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Fitchburg, Massachusetts, Dept. PW-58

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FITCHBURG, MASSACHUSETTS

dren are not permitted to ride bicycles or other vehicles on the playgrounds.

Discipline Is Important

Maintenance of good discipline is more than half the battle in getting effective supervision and safety on the playground, according to Director Hendrick. "Be firm without excessive severity," he told the leaders at the start of the season seminar. "Correct the child without antagonizing him. In extreme cases it may be necessary to refuse the use of playground facilities to a child, but make the period of time definite. Do not act in anger and be fair at all times."

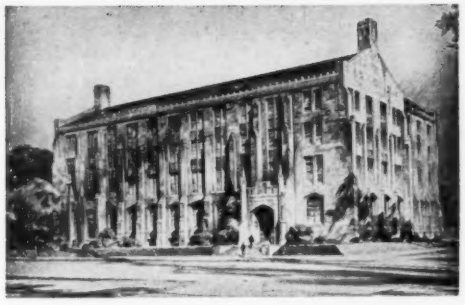
Policy making body for Niagara Falls' recreation program is the recreation commission, established in 1931 and composed of five members and two ex-officio members,

● **CASTLE tower provides plenty of fun and exercise for younger children.**

who are the director of health and physical education in the schools and the superintendent of parks. The recreation department's operating budget last year was $101,000. Of this amount, $2,000 is spent each year for new playground apparatus. The annual budget for the parks is $350,000, which includes the fund for the operation of the 75 by 300-foot swimming pool in Hyde Park.

Mr. Hendrick has many years of experience in the recreation field. He worked as a sales representative for a sporting goods company and did industrial personnel work before he became NYA director for the Western New York area in 1936. He was appointed chairman of the Niagara Falls Recreation Commission in 1937, and became director of recreation in 1944.

News BULLETINS



AMERICAN PUBLIC WORKS ASSOCIATION, 1313 EAST 60th STREET, CHICAGO 37, ILLINOIS

New Committees on Equipment and Buildings & Grounds

Chicago, Ill.—At the last meeting of the Association's Board of Directors, two new Committees were established to explore the possibility of preparing new publications on equipment management and on property management.

APWA President Sol Ellenson has appointed W. C. Wichman, Director of the Department of Public Works of Cincinnati, to be Chairman of the Association's Committee on Equipment and has named Victor Wogan, Jr., Director of the Department of Property Management of New Orleans, to head the newly organized Committee on Buildings and Grounds.

Other members of each of these Committees are listed as follows:

Committee on Equipment: L. E. McCorison, Superintendent, Equipment Division, Department of Public Works, San Diego, Calif.; W. Lowell Fisher, Superintendent of Automotive Equipment, Department of Public Works, Dallas, Texas; Harry R. Stiedemann, Superintendent, Bureau of Municipal Equipment, Department of Public Works, Milwaukee, Wisc.; R. N. Allred, Superintendent of Motor Equipment, Columbus, Ga.; Robert R. McIntosh, Director of Public Works, Battle Creek, Michigan; W. J. Booth, Superintendent of Motor Equipment, Oklahoma City, Okla., and Col. Albert W. Waterman, Commissioner of Public Works, South Portland, Maine.

Committee on Buildings and Grounds: Wm. R. Blakely, Director, Bureau of Public Buildings, Los Angeles, Calif.; Norman W. Nester, Civil Engineer, University of Illinois, Physical Plant Department, Urbana, Ill.; Herman L. Danforth, Director, Department of Public Works, Tucson, Ariz.; Walter J. Detmar, Jr., Director, Division of Building Management, Department of Public Works, New York, N. Y.; William Veasey, Superintendent, Department of Public Buildings, Toledo, Ohio; Cortlandt D. Montgomery, Chief, Planning and Administration, Engineering Branch, Division of Aviation, Philadelphia International Airport, Philadelphia, Pa.; and Walter Mayers, Assistant City Engineer in charge of Building Maintenance, Department of Public Works, Kansas City, Missouri.

Refuse Storage and Disposal Discussed at Michigan Meeting

Detroit, Mich.—A recent luncheon meeting of the Michigan Chapter of the APWA featured two excellent papers on refuse collection and disposal. The first, presented by S. G. Gentile, Administrator, Dept. of Public Works of Detroit, pointed out that suitable land for the disposal of refuse in the Detroit Metropolitan Area is rapidly being surrounded by new communities. He explained that to keep haul costs down the city has experimented with transfer stations. "Trucks assigned to certain areas were routed to a control point where they would dump their loads. A large bulldozer with crushing action compacted the material, and a basket-type crane loaded a large transfer truck which hauled the material to the landfill. This activity", he said, "accomplished two things—it decreased the hauling time of the alley trucks and reduced the volume. Today, three such transfer stations are located in strategic areas of the city."

A second paper, presented by Andrew T. Dempster, Director of the Sanitary Engineering Division of the Detroit Health Department, dealt with the health aspects of the refuse disposal problem and Detroit's program for eliminating the use of oil drums and concrete receptacles for storing refuse. He explained that his Department has found that the control of rat-borne diseases such as Weil's Disease and rat bites is basically dependent on the methods of disposal and storage of refuse.

"This fact," he said, "can be demonstrated by comparing certain districts of the city in which there is a variation in collection practices. In the portion of the city with no alleys, the citizens are responsible for placing their refuse at the curb on established pick-up days and portable containers are used for this purpose. These areas have had practically no rodent problem except for isolated locations. In the areas which do have alleys, it is the prevalent practice to hide the receptacles behind the garage or fence, and as a result careless littering of the alley occurs. In addition, the type of receptacles used in alleys have been stationary or heavy types such as concrete receptacles and oil drums. The design and construction of both of these types of receptacles are favorable to creating a source of food for rats and flies. It is in these

OFFICERS: Sol Ellenson, Newport News, Va., *President;* Wm. D. Hurst, Winnipeg, Manitoba, Canada, *Vice President.* REGIONAL DIRECTORS: (term ending 1958) Jean L. Vincenz, San Diego, Calif.; Leo Flotron, Dayton, Ohio; Roy W. McLeese, Salt Lake City, Utah; (term ending 1959) Albert G. Wyler, New Orleans, La.; Edward J. Booth, Bismarck, N. D.; Frederick Crane, Buffalo, N. Y.; (term ending 1960) Charles W. Cooke, Hartford, Conn.; R. S. Hopson, Richmond, Va.; H. H. Hester, Fort Worth, Texas. *Immediate Past President,* Robert Anderson, Winnetka, Ill. Donald F. Herrick, *Executive Director*

areas that rat-borne diseases and rat bites are most prevalent."

Western Pennsylvania Chapter to Hold First Meeting May 15th

Pittsburgh, Pa.—The twenty-ninth chapter of the American Public Works Association will be formally organized at a meeting to be held in Pittsburgh on Thursday, May 15. Plans for the Western Pennsylvania Chapter were made at a luncheon meeting of APWA members in that area on March 19. Copies of the program and further details about the meeting may be obtained from William G. Willis, Director, Institute of Local Government, University of Pittsburgh, 2317 Cathedral of Learning, Pittsburgh 13, Pa.

Other Meetings Coming Up

May 6, 1958—New Orleans, Louisiana; Stuart H. Brehm, Jr., Secy.-Treas., New Orleans Chapter, APWA, Room 4W04, City Hall, Civic Center, New Orleans 12, La.

May 8-9, 1958—Birmingham, Alabama; Joe E. Dunn, Secy.-Treas., Alabama Chapter, APWA, 1316 Fifteenth Avenue, Birmingham, Ala.

May 8-9, 1958—Nogales, Arizona; E. O. Dye, Secy.-Treas., Arizona Chapter, APWA, City Hall, Tucson, Ariz.

May 11-13, 1958—Rochester, New York; Kenneth Miller, Secy.-Treas., Up-State New York Chapter, APWA, 242 Main Street, W., Rochester, N. Y.

May 11-13, 1958—Nashville, Tenn.; Murphy Snoderly, Secy.-Treas., Tennessee Chapter, APWA, Box 8260, University Station, Knoxville, Tennessee.

May 15-16, 1958—Wauwatosa, Wisconsin; John C. Thompson, Secy.-Treas., Wisconsin Chapter, APWA, 1811 Jefferson Street, Madison, Wisc.

May 20, 1958—Columbus, Ohio; C. A. Boeke, Secy-Treas., Ohio Chapter, APWA, City Hall, Middletown, Ohio.

May 20, 1958—Spokane, Washington; Chester L. Waggener, Secy-Treas., Washington State Chapter, APWA, City Hall, Moses Lake, Wash.

May 22, 1958—Lansing, Michigan; Howard L. Lilley, Secy.-Treas. Michigan Chapter, APWA, Municipal Building, Dearborn, Mich.

May 22, 1958—Hinsdale, Ill. (Midwest Country Club); Charles V. Sramek, Secy.-Treas., Chicago Metropolitan Chapter, APWA, 5040 W. Lawrence Ave., Chicago 30, Ill.

June 15-18, 1958—San Diego, Calif.; Richard Gallagher, General Chairman, APWA Western Public Works Conference, 3708 Elliott Ave., San Diego 6, Calif.

McKinley Names Local Committee Chairmen for Kansas City Congress

Kansas City, Mo.—Plans for the 1958 Public Works Congress and Equipment Show, scheduled for Kansas City, Mo., September 28-October 1 are shaping up very well. Space allocations and the number of exhibitors contracting for space are running ahead of any previous year which indicates that an early sell out can be expected.

Reed McKinley, General Chairman of the 1958 Congress and Director of Public Works of the host city has named the following Local Committee Chairmen: Stanley Palmer, City Engineer, Management Committee; Ray Blessing, Commissioner of Streets and Sewers, Hospitality and Information Committee; H. M. Fayman, Commissioner of Motor Equipment, Exhibits Committee; Clarendon Rae, Commissioner of Refuse Collection,

Let us show you how to cut mowing costs

(Photo by The Davey Tree Expert Company)

Accurate records over a three-year period showed that weed and brush control along highways costs better than $100 a mile when mowing was the basic control method.

Comparative tests over the same period proved that a combination of chemical control with fewer mowings did a better job at far less cost. Moreover, chemicals could be applied the full width of the right of way—30 feet or more back from the roadway.

As one of the world's largest makers of herbicides, DIAMOND has the experience and technical facilities to help you map out a reliable chemical control program that avoids pitfalls. Why not contact us and let us show you how to cut highway maintenance costs? Just write DIAMOND ALKALI COMPANY, 300 Union Commerce Bldg., Cleveland 14, Ohio.

Diamond Chemicals

Hydro E-Z Packs cost less to buy, operate, maintain...

Compact Shape uses space to best advantage, permits mounting on smaller trucks, cuts initial cost to a minimum.

Faster Collection and fewer trips to the dump cut man-hours, reduce truck operating costs because load is packed en route.

Simplified Design and accessibility mean lower maintenance costs.

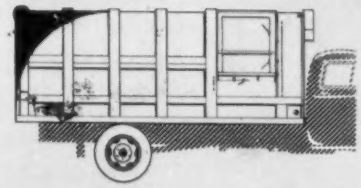
Less Maintenance means less strain on parts because hydraulics do not have to operate continuously resulting in less servicing of truck engine and transmission.

LOOK AT THESE FEATURES:

- Greater Capacity
- Large Openings on both sides and top
- Powerful Compaction
- No-Drip Body
- Simplified Hydraulic System
- Fully Enclosed Load

HYDRO E-Z PACK—THE MODERN DISPOSAL METHOD—*Write Today for Full Details*

Hydro E-Z Pack easily handles bulky objects like this washing machine—compaction method applies up to 76,800 lbs. at 1350 psi of crushing force.



Darkened area shows space increase over conventional models. Compact design permits mounting on shorter body.

Release tailgate, engage the packer—load dumps quickly, completely, safely.

HYDRO E-Z PACK

HYDRO E-Z PACK DIVISION—**HERCULES GALION PRODUCTS, INC.**, GALION, OHIO EZ-258

Tours and Inspection Committee; and A. H. Schumacher, Utilities Engineer, Dept. of Public Works, Transportation Committee. The Chairman of the Ladies Committee will be announced at a later date.

Screvane Speaks at Purdue Meeting of Indiana Chapter

West Lafayette, Ind.—The Indiana Chapter of the APWA held a luncheon meeting at the Purdue Memorial Union Building in West Lafayette on Tuesday, April 8. Paul R. Screvane, Commissioner of the New York City Department of Sanitation and Chairman of the APWA Street Sanitation Committee was the guest speaker.

His subject, "Street Cleaning Practices In American Cities", was very informative and well received by those in attendance at the luncheon. Screvane's talk dealt with four important phases of the subject: (1) Personnel, (2) Mechanization, (3) Modern Snow Operations, and (4) Litter Prevention Measures.

He explained that an analysis of information received from 100 typical cities, both large and small, located in various parts of the United States, revealed a number of significant developments. For example, 45% of the cities reported that their non-supervisory street cleaning employees were unionized; 44% indicated that such employees were appointed by following civil service procedures; 73% reported a retirement plan for employees; 59% stated that their employees were under Social Security; 72% replied that they had a group hospitalization plan for their employees and 34% indicated that the city paid for all or part of the premiums for such plans; 44% reported a group life insurance plan for their employees and 35% stated that the city paid for all or part of the insurance premiums. Since fringe benefits of this type are quite common in private industry, it is not surprising, he said, to find that many cities have adopted similar plans for their employees.

Dan Richardson, Street Commissioner of South Bend and Vice President of the Chapter, presided at the meeting in the absence of Chapter President B. J. Swanson, Chairman of the Board of Public Works of Fort Wayne, who was unable to attend because of illness. Also present at the meeting was APWA Regional Director Leo Flotron, Chief Highway Engineer of Dayton, Ohio.

Maryland Joins Virginia-D.C. Chapter

Richmond, Va.—The Board of Directors of the APWA recently approved an amendment to the Virginia-D.C. Chapter by-laws which expanded its territory to include the state of Maryland. Members of the Association residing in the affected territory recommended the change in order to strengthen the Chapter and extend its benefits to the Maryland members of the APWA. Chapter President, Robert Hopson, Director of Public Works of Richmond, Va., points out that the chapter will henceforth be known as the Virginia-D.C.-Maryland Chapter and will hold its next meeting in Roanoke, Va., Sept. 21-23, 1958. Cletus Broyles, City Engineer of Roanoke is Chairman of the Program Committee.

Public Works Officials Hold Conference at Iowa State College

Ames, Iowa—The Iowa Chapter of the APWA sponsored the ninth Annual Conference for City Engineers and Public Works Officials of Iowa at the Memorial Union

designed by a champion for championship performance

American Approved

Jim Patterson's Lifetime ALUMINUM Diving Board

World's Finest Official Regulation Board

Lifetime Construction, Unequaled Performance and Safety

RADICALLY DIFFERENT in design and construction, unequaled in performance by any other board you've seen.

BUILT LIKE AN AIRPLANE WING—Aircraft structural design combined with spring-leaf principle and heat-tempered, specially alloyed aluminum are joined in an assembly of great strength, uniform flexibility and incomparable springing qualities.

PRACTICALLY UNBREAKABLE—Many times stronger than actual load requirements—will withstand severest use day after day, yet continue to give unmatched performance and maximum springing action year after year, free of repairs or replacement.

SPRING-LEAF CONSTRUCTION gives much greater strength at fulcrum where needed, and lightness at tip.

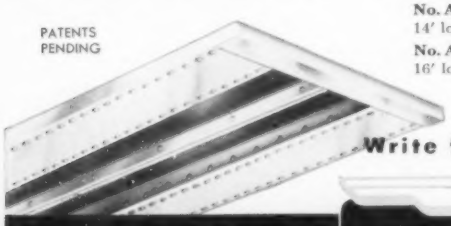
EFFORTLESS TAKE-OFFS, MORE HEIGHT WITH LESS EFFORT—No other board has such buoyant springing qualities or is so stable underfoot. Built-in resilience lasts as long as the board.

SAFEST DIVING BOARD EVER DESIGNED—Aircraft structure eliminates torque (twisting action) at tip of the board. Battleship Safety Tread, 18" wide, safest non-slip covering known.

WEIGHS LESS than conventional wood or coated wood boards, easier to install or remove. The only board that fits *any* regulation diving standard.

ENDS BROKEN BOARD PROBLEM—eliminates repair and replacement expense indefinitely, pays for itself in a few years. The entire board is anodized for permanent protection against salt water and all corrosion.

PATENTS PENDING



No. APL-14 Lifetime Aluminum Board 14' long, weight 130 lbs. . . . $329.50

No. APL-16 Lifetime Aluminum Board 16' long, weight 140 lbs. . . . $349.50

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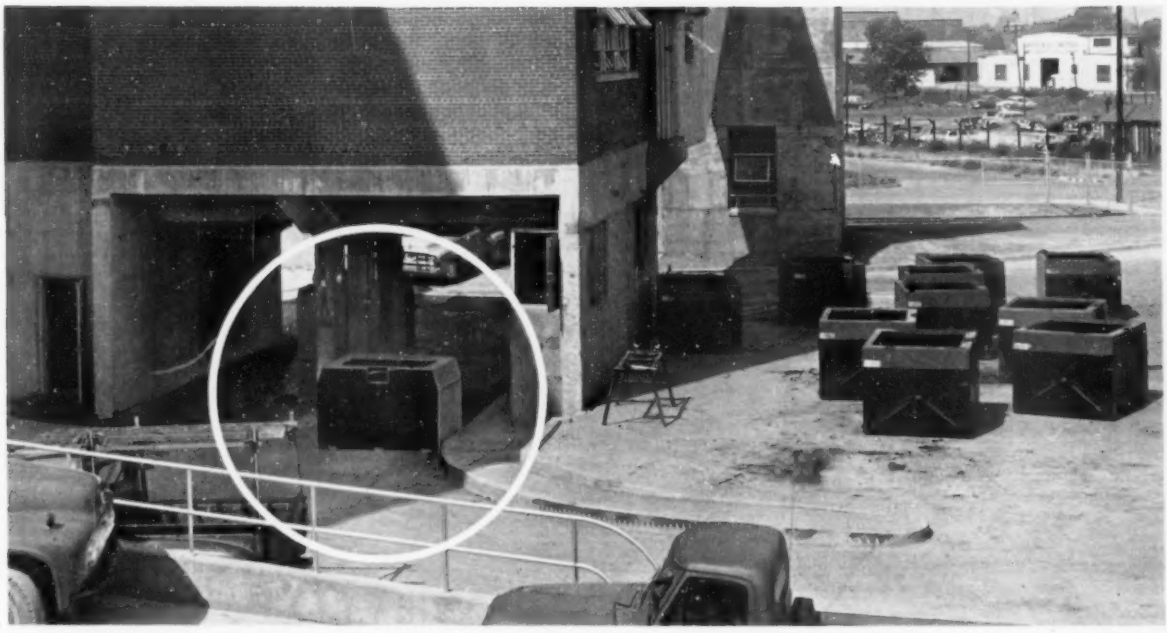
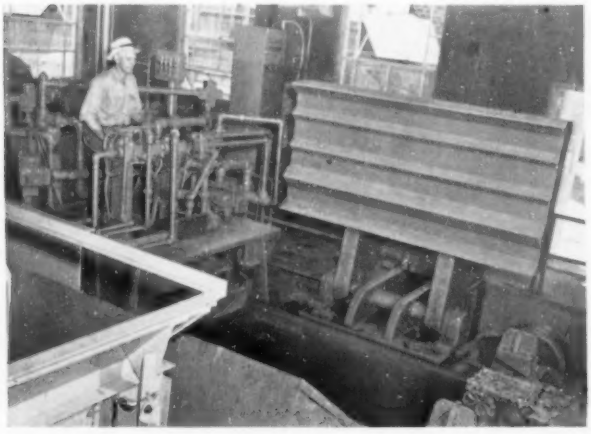
AMERICAN PLAYGROUND DEVICE CO.
ANDERSON, INDIANA, U.S.A.

How Louisville Incinerator Cuts Ash Handling Costs With the DEMPSTER-DUMPSTER System



DEMPSTER-BALESTER Turns Scrap into a $200,000 Boost for Taxpayers

Metal salvage is an important function of the Louisville Incinerator. Cans are processed, stored in a hopper and carried by dragline to a DEMPSTER-BALESTER scrap metal baling press. When the charging box is full, powerful hydraulic rams compress the scrap into a tight, easy-to-handle bale about 14″ x 14″ x 20″. Bales are ejected onto a conveyor, which drops them into waiting cars on the railroad siding . . . yielding the city an estimated $200,000 annually from scrap sales.



Like the proverbial packing house, Louisville's Incinerator "uses all of the hog but his squeal." Dried sludge is sold for fertilizer, and scrap metal is baled at a profit. Even the residue ash is valuable for land fill and dump sealers.

That's where the DEMPSTER-DUMPSTER System steps in. Six-cu.-yd. detachable containers are placed under the ash residue hopper to provide temporary storage. The containers are filled on a 24-hour basis and stored out of the way until they can be emptied by the day shift. This pays off in fewer trucks and bigger savings. Ash is hauled to the disposal area and automatically dumped by the one-man-operated DEMPSTER-DUMPSTER.

Hats off to Louisville and its progressive Director of Sanitation, John Leake. We are proud to be a part of one of America's model incinerators.

If you are planning or building a municipal incinerator, write us today. One of our sales engineers will call without obligation and explain our system.

Mfg. by Dempster Brothers, Inc.

DEMPSTER DUMPSTER®

DEMPSTER BROTHERS

Knoxville 17, Tenn. Dept. PW-5

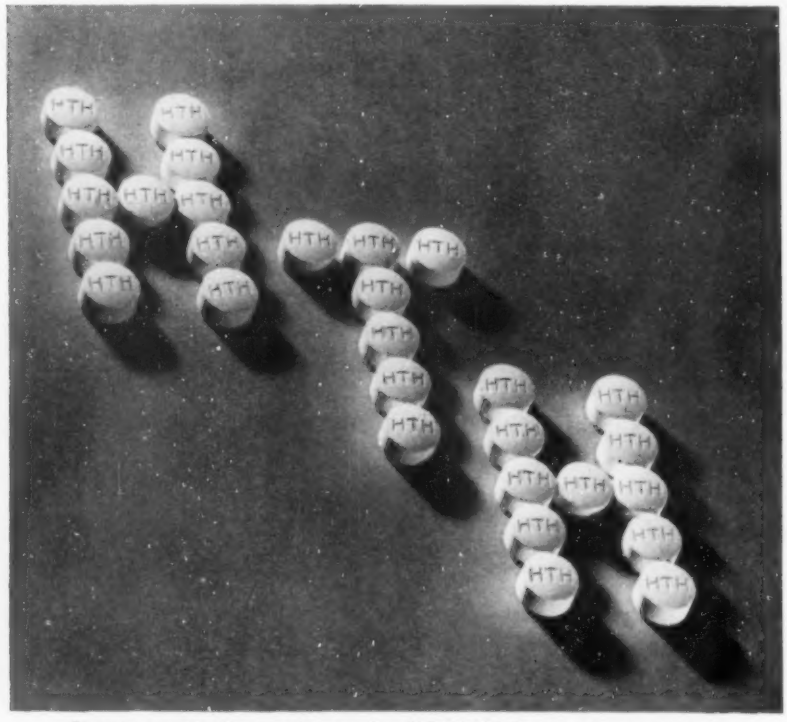
Building of Iowa State College on March 12 & 13.

William D. Hurst, City Engineer of Winnipeg, Manitoba, and Vice President of the Association was the featured speaker at the luncheon on the opening day. Other speakers and topics on the action-packed program are listed below:

Lowell Berg, Outdoor Lighting Specialist of the General Electric Co. spoke on "Modern Trends in Street Light Planning"; James Brophy, Street Commissioner of Madison, Wisc., discussed "Snow and Ice Removal Methods and Operations"; Norman Erbe, Attorney General for the State of Iowa talked about "Legal Aspects of Special Assessments"; and Lloyd Dove, City Engineer of Ames, presented a paper on "Assessments of Storm Sewers in Ames."

The head of the Iowa State College Library was the guest speaker at the Annual Dinner Meeting. The second day's program included a talk on "Dutch Elm Disease and Its Treatment", by Harold S. McNabb, Jr., of the Forestry Department of ISC and K.S. Oleson, Asst. Professor, Engineering Extension for the college discussed "The Need for a Technical Institute for Iowa".

Other subjects discussed at the Conference were: "City Streets in a Correlated Transportation System", by Kenneth Cullen, City Engineer, Dubuque; and "Keep America Beautiful", by Chas. A. Fahey, Executive Director, Citizen's Committee for a Cleaner Chicago.



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SURVEYS, SUBDIVISION AND PLATTING, AND BOUNDARIES

Washington State Laws and Judicial Decisions on surveys, subdivisions and platting, and boundaries are covered in a 175-page book from the University of Washington Press, Seattle, Wash. Very good information for city engineers, surveyors, civil engineers and attorneys. Copies are $3 each.

ELEMENTS OF WATER SUPPLY AND WASTE-WATER DISPOSAL

A shorter and somewhat simplified version of an earlier work, by the same authors, Gordon M. Fair and John C. Geyer, "Water Supply and Waste - Water Disposal" (1954), "Elements" is directed specifically toward undergraduate civil and sanitary engineering students. However, much of the text, graphs and illustrations are the same or similar, making the publication a good refresher course for city and county sanitary engineers and practicing engineers. The book devotes the first chapter to a review of the whole field, about 100 pages to analysis of precipitation and runoff records and to collection of surface and ground water, including methods of statistical evaluation of surface sources. Some 60 pages are concerned with sewer collection practice and drainage system design. The balance of the book presents the subjects of examination of water and wastes, principles of treatment, stream behavior, and industrial water and waste practice. The appendix includes useful tables, a well-arranged bibliography, and a number of typical problems organized by chapters. Many excellent line drawings and charts contribute much to the subject matter. The publisher is John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y. The price is $8.95.

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King Size Features create a new approach to Refuse Collection!

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Designed and Engineered to Bring Greater Efficiency and Economy to Refuse Collection Operations

Write for "The King of All Refuse Fleets and Systems" and the name of your nearest PAK-MOR Distributor.

AIR PLACED CONCRETE
Trims Curb Repair Costs

M. E. RADER
Superintendent, Street Division, Department of Public Works, San Diego, California

A STUDY was initiated in 1952, by the City of San Diego, Calif., to establish a low-cost program for repairing deteriorated curbs and improving appearance.

Under the then existing method, all curb repairs were made by removing the defective section, forming, and then pouring with new concrete. The unit cost per foot for this type of repair was expensive, and as a result only the worst of the curbs were repaired. Placing of barricades and lanterns for several days over the new repair also added to the total cost and constituted an inconvenience to adjacent property owners. It was soon realized that if the job were to be done economically and quickly a new repair procedure would be required.

In 1953, an experimental program was begun in which the air placement, or gunite method of applying concrete was used. Since this process was experimental, equipment on hand was modified for the first trial. The gunite machine was hoisted onto a 2½-ton flat bed truck and secured with rope. The air supply was furnished by a tow-type compressor hitched to the back of the truck and a water sprinkler truck was used to supply water. The crew of men consisted of one nozzleman, two cement finishers, one operator for the gunite machine, one laborer and one equipment driver. This arrangement was commonly referred to as the "Circus Train."

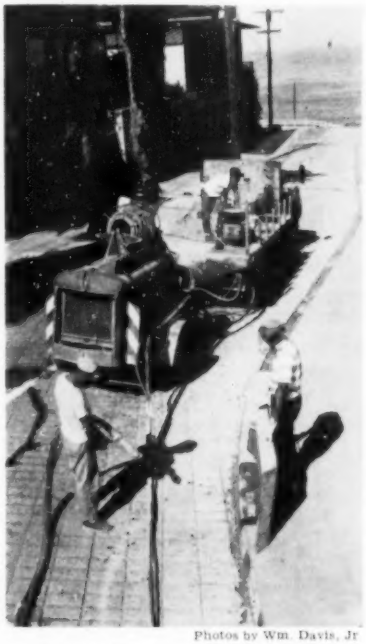
One of the problems frequently encountered by other cities in making gunite curb repairs was the impermanency of such a repair. It was found that by employing an experienced nozzleman and proper preparation of the defective curb section prior to guniting, the applied material had a high degree of cohesiveness. It was also found that it was necessary to keep vehicular traffic clear of the new work for an extended period of 2-4 hours since motorists could damage the fresh repair in the course of parking.

The results of the test program were gratifying and work was started to institute this method as part of the regular street maintenance curb repair program.

A matter of concern, however, was that of finding a light but serviceable dual-purpose sandblasting and gunite machine which could be mounted on a flat bed truck. A Bondactor, Model 750 (Air Placement Company, Kansas City, Mo.) was purchased in January, 1954 and placed inside an especially constructed well at the right rear corner of a 2½-ton flat bed. The water supply comes from a 40-gallon tank located under the right front corner of the truck bed and air is furnished by a 160 cfm tow-type two-wheel compressor. The unit was thus complete and compact and could operate in any section of the city with a minimum of traffic interruption. The complement of the crew remained the same as used in the experimental test.

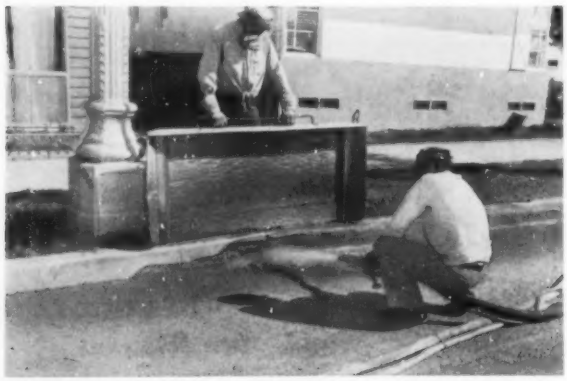
At present a 55-gallon tank is being considered to allow a full day's operation on one filling and a new rotary type compressor is on order which may be mounted behind the cab.

In order that the curb will be cleared of parked automobiles prior to starting the job, temporary signs stating "No Parking—Street Repairs" are posted the preceding day. Under California State Law, these



Photos by Wm. Davis, Jr.

● **EQUIPMENT used for curb repair work. Bondactor is mounted on a flat bed truck which carries special tank for water and tows 160 cfm air compressor. This same equipment can be used for other light gunite construction projects.**



● **WORKMAN shown guniting defective section of curb. The second man holds backboard to keep excess material off walk.**

● **APPEARANCE of curb after restoration. Scattered dark areas show extent of reconstruction. Cost runs 7-8¢ per ft.**

signs are required to be posted 24 hours ahead of work before becoming effective. Experience has shown that under average conditions, it is possible to restore about 3,000 lineal feet of curb per day. All the defects in the area are prepared on the first pass by chipping where required and sandblasting with a regular sandblasting nozzle at approximately 25 psi air pressure. The equipment is then changed for concrete placement. The machine operator fills the hopper with a gunite mixture consisting of 3½ parts of a hard, durable sand and 1 part of Type I portland cement. For ease of handling in the field, this mixture is batched, mixed dry in a small concrete mixer and loaded onto the truck in sacks at the Public Works Yard before departure to the job site. During the course of a normal day's work, approximately 8 sacks of gunite mix is applied and 3 sacks of silica sand for sandblasting are used. The second stage of the operation is essentially a repetition of the first, except that the prepared spots are filled with material using a standard nozzle at approximately 25 psi pressure. Immediately following the nozzleman are two cement finishers who steel trowel the patch and spray with curing compound.

Of the 10 million feet of curb on inventory within the City, approximately 300,000 lineal feet were budgeted for repair by the gunite method during the fiscal year 57-58. Since there are numerous areas with many small defects calling for gunite treatment, the cost accounting unit selected was "lineal feet of curb restored" rather than measuring each increment of repair. The total cost for labor, material and equipment has averaged between 7 and 8 cents per lineal foot for the past three years. The man-hour per unit rate over the same period has averaged 0.02 man-hour per lineal foot. By comparison, during the same period the unit cost of repair by the removal, form and pour method, averaged $2.75 and required 0.76 man-hour per lineal foot.

• • •

Utility Construction for Subdivisions

On five subdivisions in Cuyahoga Falls, Ohio, the construction of 259 residences required 6,253 lineal feet of pavement; 12,465 ft. of curb and gutter; 8,277 feet of sanitary sewer; and 10,992 ft. of water lines. These data are included in the 1957 annual report, sent us by Geo. F. Johnston, City Engineer.

boosts trench production 500%

SPRINGFIELD, N. J. contractors, Ern Construction Co., increased production more than 500% by replacing a backhoe with a Cleveland 110 on 11,000 feet of trenching for 8 and 12-inch pipe, digging 2 feet wide by 5½ feet deep.

"The 110 got us 780 feet of trench per hour where we had been getting only 100-150 feet with the backhoe," reports Ern Foreman Henry J. Appleby. "Our operator got top production with the Cleveland after only 5 days experience at the controls. He was one of our regular work crew and had no previous training as a trencher operator."

Ern also saved 25% on his repaving costs with the narrow, clean accurate trench produced by his Cleveland 110.

The CLEVELAND TRENCHER Co.

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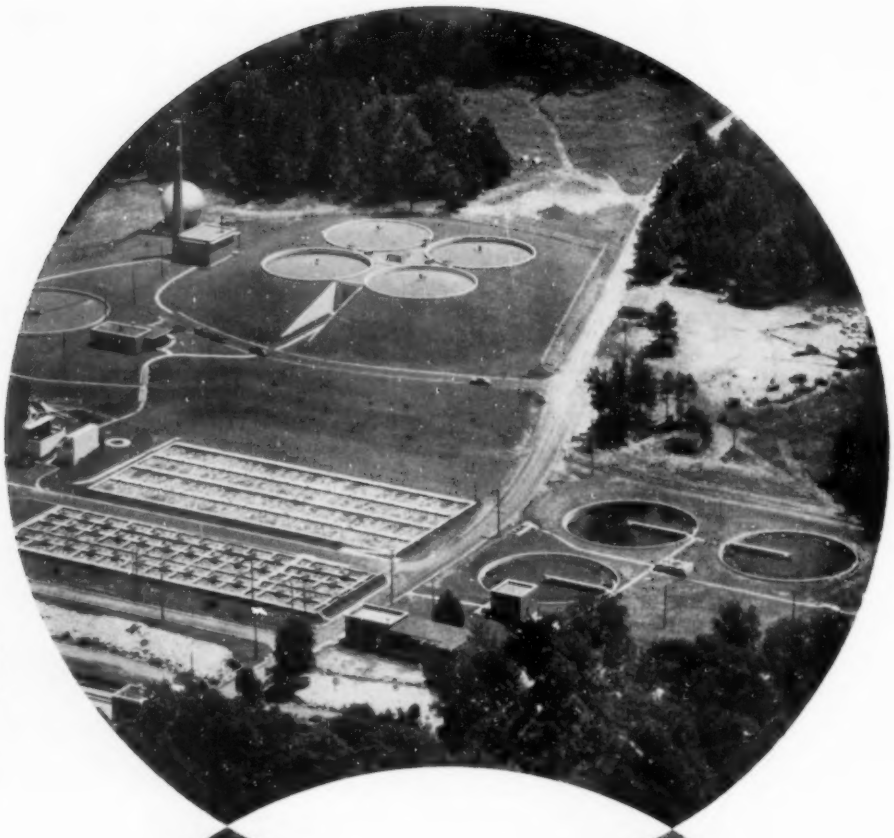
Good Everywhere ®



DOUBLE BARRELED BENEFITS

at Charlotte, N. Car.
with TFFI specification
vitrified clay
underdrain blocks
for sewage plants

TFFI TRICKLING FILTER

Major Equipment by:

Process Engineers, Inc.,
Pacific Flush Tank Co.,
Link-Belt Co.,
Fairbanks Morse & Co.,
Chicago Pump Co.,
Marlow Pumps Division,
Bell and Gossett.

General contractors:

Rea Construction Co.,
Charlotte, N.C.

Originally designed by:

Wm. M. Piatt,
Consulting Engineer,
Durham, N.C.

VERSATILITY PLUS VITRIFIED CLAY BLOCKS

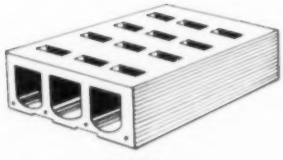
Trickling Filters at Charlotte sewage treatment plants were designed to treat combined domestic and industrial wastes. This called for flexibility and adaptability, and *they* called for tricking filters. Much of the success of these filters, in turn, has been due to the selection by the engineers of **Vitrified Clay** underdrain blocks of standard **TFFI** design and manufacture.

TRICKLING FILTERS HAVE THESE OTHER BIG ADVANTAGES

Low first and operating costs. Simple, easy operation. Long life—longer than that of the bonds issued to pay for the plant. Overload is no problem. Good results: top-notch effluent, day in and day out.

BEAR IN MIND THESE FURTHER IMPORTANT POINTS

Vitrified clay TFFI specification blocks for trickling filter underdrain systems have other advantages which designing engineers can count on. They give *permanent* protection against acids, alkalis and bacterial actions which no blocks made from a substitute material can possibly offer. Clay blocks are inherently superior because they are manufactured under rigid controls usually impossible with substitutes. ASK US ABOUT OUR 50-YEAR GUARANTEE OF **VITRIFIED CLAY BLOCKS.**



DICKEY
W. S. Dickey Clay Mfg. Co.
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BOSCO
Bowerston Shale Co.
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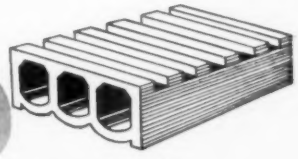
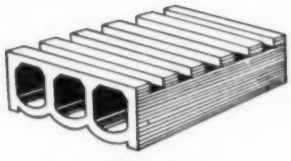
POMONA
Pomona Terra-Cotta Co.
Pomona, No. Car.

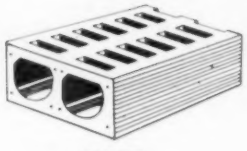
FLOOR INSTITUTE



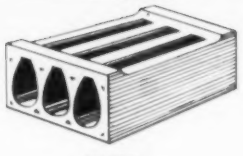
TRANSLOT
Texas Vitrified Pipe Co.
Mineral Wells, Texas



TRANSLOT
Cannelton Sewer Pipe Co.
Cannelton, Ind.



ARMCRE
Ayer-McCarel Clay Co., Inc.
Brazil, Ind.



NATCO
Natco Corporation
Pittsburgh 22, Pa.

PUBLIC WORKS DIGESTS

Prepared by
ALVIN R. JACOBSON, Ph.D
Associate Professor and Head,
Division of Sanitary Science,
Columbia University School of Public Health

THE WATER WORKS DIGEST

Distance-Demand Water Rates

Kansas City has pioneered the use of a two-part rate for water service which is very similar to the electrical power service rates, i.e., the total charge for service includes a charge for maximum demand and a separate charge for the total amount of power used. Actually Kansas City's demand rate goes one step beyond electric power rates. It includes a factor for distance—in this instance the distance from main pumping stations to the point of delivery. The distance factor is in recognition of a point not too often brought to light in water rate practice; namely, that the transportation of water accounts for a substantial part of the cost of water service. In Kansas City, this cost—that is fixed on trunk mains and not including pumping expense—accounts for about 25 percent of the cost of service to suburban users of water. The application of the rate requires equipment that will record graphically the flow of water through the customer's meter or meters. The Kansas City system provides water service to about 660,000 people. Of this number, 165,000 people are living in areas outside of and adjacent to the City. There are 20 municipal and private agencies purchasing water from the Kansas City system through 30 separate metering stations ranging in distances of 1.4 to 12.8 miles and averaging 7.8 miles from the main pumping station. The distance factor in the distance-demand rate is designed to insure a proper distribution of the cost of transporting water from the main pumping station to these widely separated points of purchase. Then, in addition, the load factor varies over a wide range. In those areas that are predominately high-standard residential, the ratio of the maximum to the average daily demand for the year will be as much as 300%, or three to one. This ratio is reduced to 125% to 150% in areas having smaller lawns and more commercial or industrial service. The maximum daily demand is a measure of the need for the capacity of certain production and transmission facilities and the fixed charges on these facilities account for better than one third of the cost of water service in Kansas City.

"Metering to Establish Distance-Demand Water Service Rates." By Melvin P. Hatcher. PUBLIC WORKS, April, 1958.

Algae Control

The article describes laboratory and field tests to determine the effectiveness of the substituted urea compound 3-(p-chlorophenyl)-1,1 dimethylurea (CMU) as an algacide. Fourteen concentrations of CMU, ranging in an arithmetical series from 0.004 to 32.0 ppm, were tested against 33 species of algae. It is concluded from the results of both laboratory and field tests that CMU is an effective algacidal agent. The relatively small amount required, the duration of its effectiveness, and its low toxicity to fish and man make it a desirable prospect for algae control. It has the characteristics of being a selective herbicide at certain concentrations, however, and therefore it may be a soil sterilant at higher concentrations.

"Control of Algae With Chlorophenyl Dimethyl Urea." By Thomas E. Maloney. *Jour. AWWA.*, March, 1958.

Water for Northern Outposts

Out of Operation Pine Trees—construction phase of the aircraft weather and early warning radar stations in the Far North—comes knowledge of how to design and build small water supply facilities in areas of permanent freeze where winter temperatures go to 60 below zero Fahrenheit. Most of the water sources are lakes, and these can freeze to as deep as 6 ft. Electricity is used to heat the water on the suction side of the pump as it is drawn from below the maximum depth of ice in the lake. The water is then further heated in the well-insulated transmission line on its way to the enclosed storage tanks at the campsite. Since electricity is expensive in those areas, and power failures would result in damage to full pipe-

Truck Fitted to Serve County Water Works Division

Courtesy Dodge Division

● **SERVICE and repair vehicle of the Water Works & Utilities Division, office of the Los Angeles County Engineer. This is equipped with two-way radio, loud speaker and a special tool box for wrenches and fittings. Pipes are carried in the truck bed.**

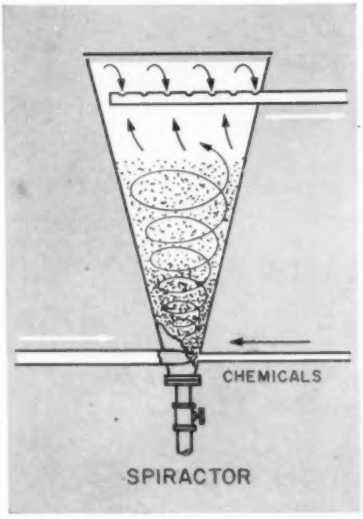
HOW TO SELECT WATER-CONDITIONING EQUIPMENT (NO. 3 OF A SERIES)

Precipitation Equipment

Basically, precipitation equipment converts water impurities to the form of large, dense, suspended particles; then it separates these particles from the water.

The first step is accomplished with chemicals. Hardness, for example, is precipitated by adding lime (and soda ash, if required). The precipitated hardness and other suspended impurities such as turbidity or oxidized iron and manganese are made to coalesce into larger particles by adding alum or iron salts. These salts also form their own dense, floc-like precipitate which absorbs the suspended material to form even larger particles.

The insoluble particles must then be separated from the water. Early methods used settling basins where precipitates settled slowly as the water flowed through, requiring 2 to 4 hours or longer detention time. Modern equipment keeps precipitates in suspension to serve as nuclei on which fresh precipitates form. This results in larger, denser particles that absorb more of the fine particles and are more easily separated from the water.



SPIRACTOR® for softening clear hard water.

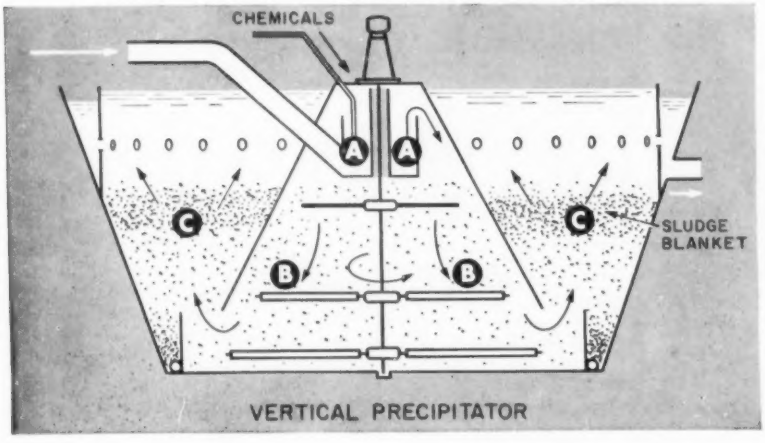
The water, lime (and soda ash if required) enter at bottom of cone. The treated water rises with a swirling motion and suspends a bed of fine granules of calcium carbonate or other catalyst which speed softening reactions. The precipitated hardness deposits on the granules which become heavy and work down to the bottom of the cone where they are drawn off then easily dried and dumped. The softened water rises above the bed of granules to the outlet.

Provides very high flow rates in relation to its small floor space. Detention period: 8 to 10 mins. Recommended for municipal or cooling water.

PRECIPITATOR for removing hardness, turbidity, color, iron, manganese.

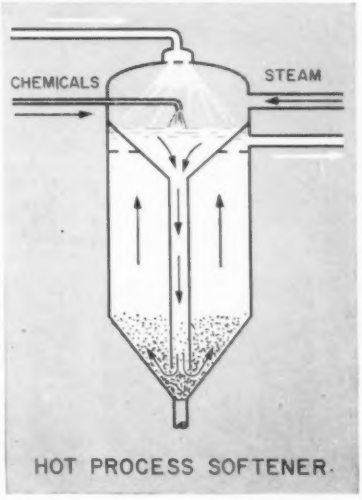
Chemicals are mixed with influent at A. As water flows downward through zone B, precipitates form, "seeded" by recirculated sludge. At C, floc has formed a sludge-blanket filter suspended by upward motion of the water. Excess sludge is concentrated and periodically drawn off.

Because of short detention time, capacity is about 4 times that of conventional coagulation and settling basins of the same size. Basic designs include vertical types as illustrated, vertical types for installation in existing tanks, horizontal types built into new or existing concrete basins and smaller "package" types for bottling plants, etc.



HOT PROCESS SOFTENER for removing hardness and silica from boiler feedwater.

The water is first heated to within a few degrees of boiling by spraying through steam. Then it is mixed with softening chemicals which react very rapidly and efficiently at this temperature. It then flows down to the bottom and upward through a suspended sludge blanket of precipitated solids which effectively reduces silica and filters out the bulk of the turbidity. Combination softeners with built-in condensate heater and storage compartment and/or steam scrubber (deaerator) are also available.



The effluent is filtered to remove last traces of suspended matter. Where zero hardness is required, Hot Process Softeners may be followed by a zeolite softener.

• • • •

For detailed information on these or any other types of water conditioning equipment, write: The Permutit Company, Dept. PW-5, 330 West 42nd St., New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

PERMUTIT®
rhymes with "compute it"
A Division of PFAUDLER PERMUTIT INC.
Water Conditioning
Ion Exchange • Industrial Waste Treatment

lines, design called for intermittent operation of the water system, and full drainage between operations. The heated water is sent through a cross-country heated pipeline which is above grade and at a continuing slope from pumphouse to storage tank. A zig-zag pattern was followed in laying the pipeline, allowing for expansion and contraction. Adequate amounts of water throughout the five years of operation has been due to the location of good sources of supply and to the novel, but necessary, design features.

"Water for Our Far North Outposts." By J. L. Staunton and S. Rosanoff. *Engineering News-Record*. March 27, 1958.

Chicago's New Filtration Plant

In about four years, Chicago's new Central District Filtration Plant will be completed with a capacity of 960 mgd based on a filtering rate of 2 gallons per sq. ft. per min. Its actual capacity will be much higher because it will be operated at a higher filtration rate. The plant is being built at a cost of approximately $90,000,000 to provide filtered water to about 3 million people residing in the northern two-thirds of Chicago and its adjacent suburbs. This plant, in conjunction with the South District Filtration Plant, will provide water for the 4,600,000 people living in the Chicago area. About 61 acres of Lake Michigan were dewatered inside cofferdam walls as a site for this filtration plant which will be the largest in the world when completed. Railroad tracks will be provided along the side of the plant for delivery of chemicals and other essential supplies. There will be a new raw water intake 20 ft. in diameter and two 16-ft. filtered-water tunnels. The treatment plant will consist of slow-mix channels of the around-the-end type, settling basins of the two-level type, and a filter plant in two units, each unit having forty-eight 10-mgd filters or a total of 96 filters rated at 2 gal. per min. per sq. ft. The clear wells with a capacity of 60 million gal. of filtered water are located beneath the filters. Chemical treatment will consist of the addition of alum for coagulation, activated carbon for taste and odor control, lime for corrosion reduction in the distribution system, ammonium sulfate for prevention of chlorinous tastes, and fluoride for prevention of dental caries.

"World's Largest Filtration Plant." By Dick Van Gorp. *Civil Engineering*, March, 1958.

New Iron-Removal Softening Plant

The 6,200 residents and the varied industries of Wapakoneta, Ohio, are assured of an adequate supply of iron-free, softened well water as a result of a $575,000 five-phase water supply improvement program completed in 1957. The project was designed and constructed in five phases: Section A—two wells; Section B—elevated steel water tank with a capacity of 500,000 gallons; Section C—feeder mains and local water mains; Section D—well pump building, well pumps, raw water force main and waste wash water sewer; and Section E—water treatment plant. Section E was the final phase of the project. It included the construction of a 2-mgd water treatment plant and alterations to the existing high-service pumping station and softening plant. The 2-mgd plant includes an aerator, a reaction basin, filter building, a 400,000-gallon clear water reservoir to replace the existing receiving well, a wash water pump building and a new salt storage tank. The treatment plant is constructed of reinforced concrete with a concrete block superstructure faced with

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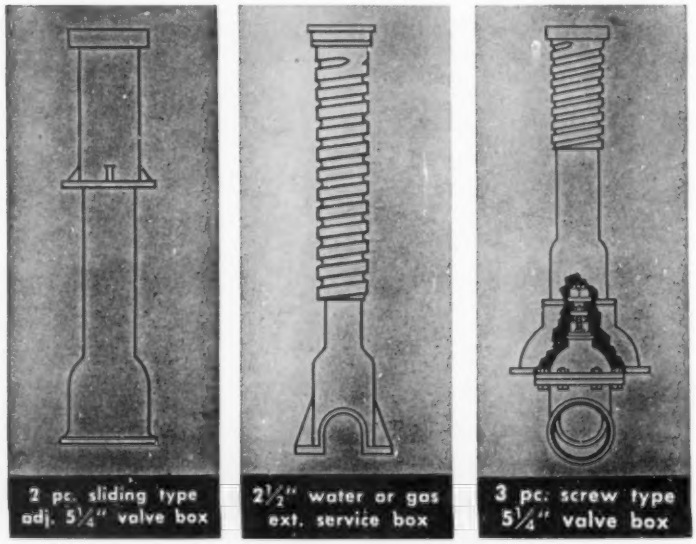

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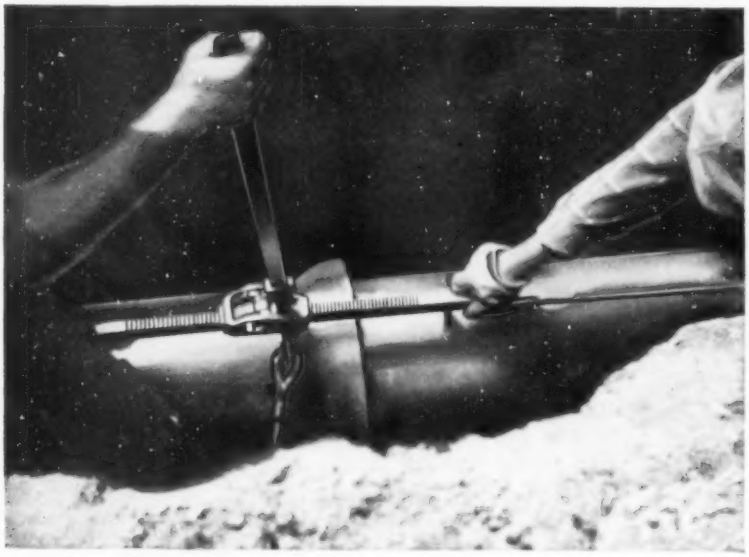
brick. The improvements to the entire system were financed by issuing mortgage revenue bonds in the amount of $575,000.

"New Iron Removal-Softening Plant Modernizes Inadequate Well System." By Joseph D. Pavia. *Water Works Engineering*, March, 1958.

A Way to See Into the Earth

Some of our resources obligingly exist on the surface of the earth; some, such as ground water and oil, must be obtained from hidden subsurface areas and are not easily appraised or harvested. Geophysical logging of borings is a practical means of obtaining reliable data on the undisturbed earth near the walls of a bore hole. This technique is based on the premise that there are measurable differences in the physical-chemical properties of geologic formations. The measurements of these differences and the recording of them on a chart correlated with depth result in a geophysical log. Logging is accomplished by lowering a sonde down the length of a bore hole. Electrical signals in each logging operation are sent up the cable to an amplifying, converting and recording instrument at the surface. The two principal types of logging are the electrical and gamma ray types although other techniques have their place in the ground water and soil mechanics industries. Properly interpreted, geophysical logs can indicate zones of maximum transmissibility and thus guide the length and settings of well screens. Results are better well efficiency, lower construction cost and maximum length of life. By comparing the physical properties of aquifers at several test hole locations the best area for permanent well construction can be selected. The chloride content of ground water can be appraised when properly integrated with scattered chemical analyses, showing the relationship between chlorides and total dissolved solids. As a result, well fields can be selected that will produce water of better mineral quality. Use of existing geophysical logs of wildcat oil tests through a wide area enables Federal or State geologists to appraise ground-water resource conditions in a large region and to guide large water-using industries and municipalities in directions best suited to expanding ground-water withdrawals. These municipalities and industries need only to appreciate better what geophysics can do, and how it can save them money and at the same stroke improve their results.

"A Way to See Into the Earth." By John W. Foster. PUBLIC WORKS, April, 1958.



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CAST IRON PIPE *IS EASY TO LAY*

No bolts, no wrench, no lead pot or calking tools. The only joint accessory is a Tyton Gasket. You simply insert the gasket into the bell and then push two pipes together. Photo above shows use of a jack to force the plain end into the Tyton bell on sizes 10″ and larger. On sizes 8″ and smaller, the two pipe may be joined with a Fork Tool or a crowbar. Write for illustrated literature. *Patent Pending. Trademark ®

IMMEDIATE SHIPMENT 2″ & 2¼″ THRU 12″

McWANE CAST IRON PIPE COMPANY
GENERAL OFFICES & FOUNDRIES, BIRMINGHAM, ALA.
Sales Offices: Dallas Chicago Kansas City New York Birmingham

Water From Lake Michigan

By the end of 1956 the City of Holland, Mich., had completed its new water supply and was assured of an adequate supply for many years. The community had outgrown its well supply which was gradually increasing in hardness to 265 to 450 ppm, depending on which well was sampled. Production from the wells dwindled until December, 1956, when the last "dependable" well failed. Fortunately for the city, this problem had been recognized in 1953 and a solution was being developed. The city took the bold step of abandoning a cheap but limited source in favor of going to a comparatively expensive but unlimited supply of good quality water from Lake Michigan. Initially, this supply delivers 14 mgd and can be easily and economically expanded to supply a maximum of 40 mgd as the demand increases. The components of this new system are: The lake intake; low-service pumping station; chemical building; filter wing; settling basins; ground stor-

age tank; and transmission line. Also included in the construction program were extensive improvements to the distribution system. The cost of the entire improvement program totalled $2,700,000.

"Replacing Dwindling Well Supply with Water from Lake Michigan." By Ralph A. Taylor. *Water Works Engineering*, March, 1958.

Membrane Filter

The author has made a comprehensive review of the present status and acceptance of the membrane filter, the research being undertaken and further research indicated. The usual procedure for bacteriological assays of interest to sanitary authorities entails (a) aseptic filtration of the samples (concentration and deposition of organisms from the suspending fluid) onto or very near the surface of a sterile membrane; b) inhibited or selective growth of the retained organisms; and (c) enumeration by direct observation. The basic technic can be modified in several ways, or the membrane alone can be used as an adjunct to other qualitative or quantitative tests. An extensive section of this article deals with the membrane filter technic as it applies to bacteriological water examinations. Additional applications of interest to sanitary authorities are also enumerated.

"What You Should Know About the Membrane Filter." By Edmund J. Laubusch, M.S. PUBLIC WORKS, April, 1958.

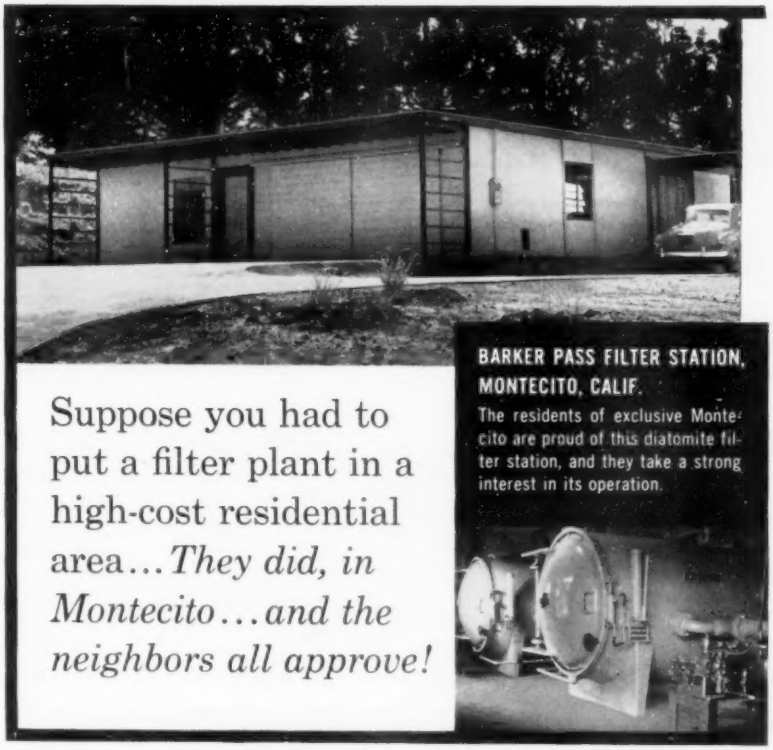
Ohio River Analyses

The purpose of this article is to describe how the Ohio River Valley Water Sanitation Commission (ORSANCO) has obtained basic data on quality conditions and flow variations. The following aspects of the program are described: 1) Genesis of the ORSANCO project; 2) methods of operation; 3) special monitoring activities; 4) assembly and evaluation of data; and 5) cost information.

"Ohio River Water Quality and Flow." By Edward J. Cleary and David A. Robertson, Jr. *Jour. AWWA.*, March, 1958.

Fluoride Reduction

This article describes a method of treating a soft, highly mineralized, well water supply at LaCrosse, Kans., to reduce the fluoride content from 3.6 to 1.5 ppm. The method consists of adding 225 ppm of alum in increments during rapid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The 1st of 2 advertisements on this installation

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Housed in a building which harmonizes with those in the area, the entire installation occupies only a single residential lot... in fact, before re-zoning, it had been a residential lot.

Two filters, each with 600 ft² of filter area, filter 900,000 to 1,000,000 gallons of water per day into the District water system, yet the installation of filters, precoat tank and slurry feeder tank is housed in one room only 20′ x 40′. Labor averages less than 1½ man-hours per day. Total cost of this filter station, including land, structure, filter system and all piping, was held below $100,000.

Yes, they use Dicalite as the filteraid—Dicalite Speedex, to be exact, with a fibrous additive when precoating.

Dependable GLC GREAT LAKES Dicalite® DIATOMACEOUS MATERIALS

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Philip Kobie, Superintendent of this Water Plant in Berea, Ohio writes: "Prices quoted to us were very good and orders were shipped without delay. This was appreciated because we only had a limited time to do this job. We will recommend this company anytime to any and every one."

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are carefully laid out. The Effective Sizes and Uniformity Coefficients used by Consulting Engineers and also recommended by the American Water Works Association are the result of long years of research and experience.

The Northern Gravel Company is equipped to give you prompt shipment whether it be one bag or many carloads, exact to specifications. Filter sand can be furnished with any effective size between 0.35 MM and 1.20 MM.

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of the filter sand is also important. It must be hard, not smooth, and free of soluble particles. This requires perfect washing and grading facilities. We have every modern device for washing, drying, screening and testing.

Filter Gravel

supporting the Filter Sand Bed must be, in turn, properly graded to sizes calculated to support the Filter Sand, and be relatively hard, round and resistant to solution.

Northern Gravel has no equal in facilities and our reserves of both sand and gravel are inexhaustible. Northern Gravel Company has been in business over 40 years. We guarantee uniformity of products and our records enable us to duplicate your requirements on short notice. Our location is central and we have commodity rates in every direction.

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Muscatine, Iowa

Box 307 Ph.: Amherst 3-2711

mixing and flocculation, followed by settling and rapid sand filtration. By chlorinating the raw water, iron and manganese are removed in the process. The method is one which should not be overlooked for treatment of other soft, high-fluoride water supplies. The cost for chemicals (alum and lime) at this location is 5.8 cents per thousand gallons.

"Fluoride Reduction at LaCrosse, Kans." By Russell L. Culp and Howard A. Stoltenberg. *Jour. AWWA.*, March, 1958.

Other Articles

"How **Metered Water Accounts** are Kept Under Inventory and Control." Two visible filing systems, working to complement each other, are providing the means for complete control of water meter accounts at the City of North Miami Water Department. By D. W. Jones. Water Works Engineering, March, 1957.

"Imported" **Multiple-Source Waters** Help Make San Diego "Desert-Proof"." Specialized technical groups control chemical treatment, corrosion and maintenance methods at the centralized Alvarado filter plant which is supplied from eight city-owned dams and the Colorado River. By Forrest E. Allison. Water Works Engineering, March, 1958.

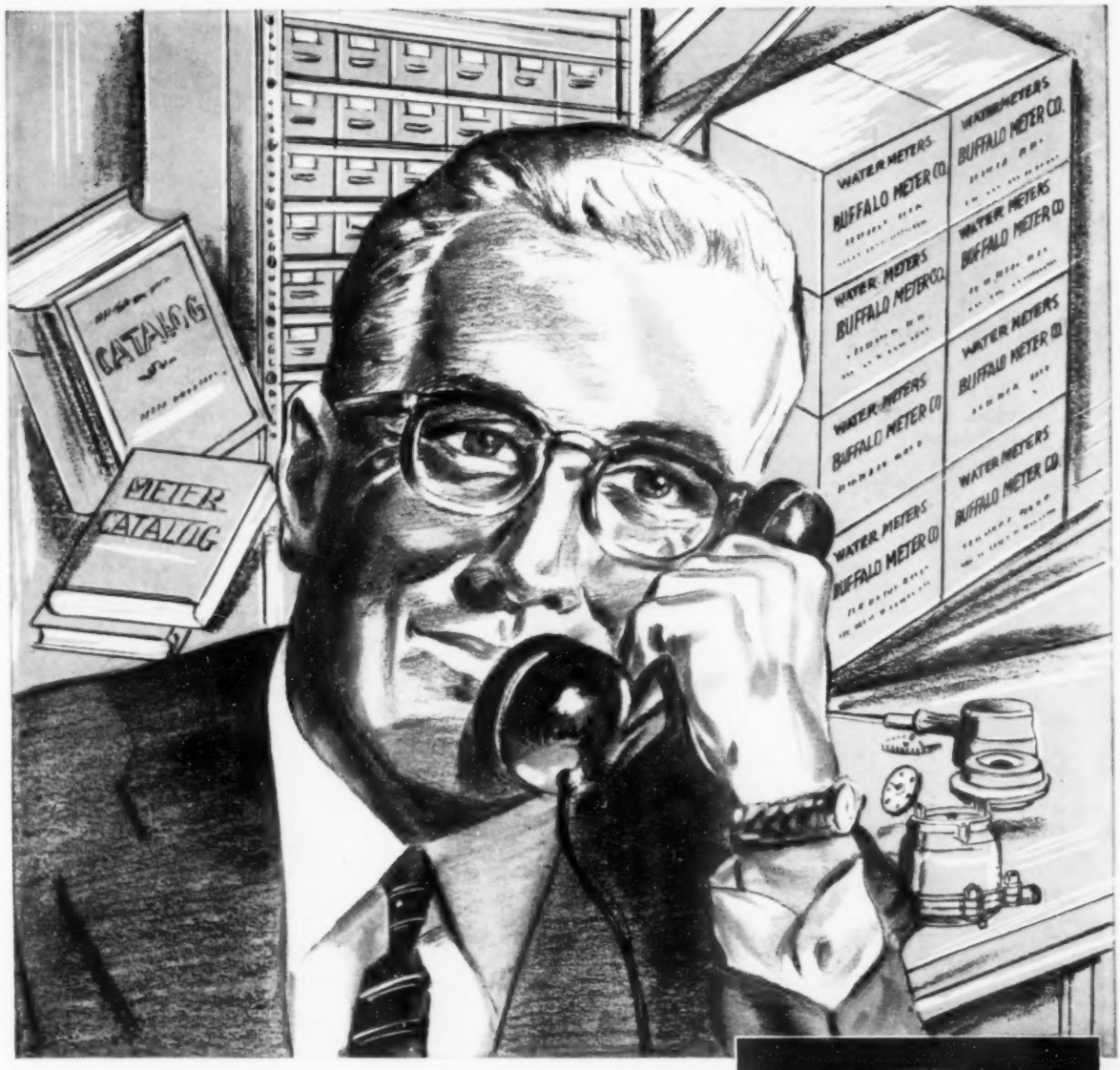
"**Consumer Complaints.**" The three papers in this group provide a behind-the-scenes glimpse of the different steps taken by these companies to assure prompt response to complaints and inquiries. They also point out the necessity of constantly adhering to the principle of maintaining the friendliest of customer relations. By Robert E. Hollander, G. V. Schultetus and G. Leland Watson. Water and Sewage Works, March, 1958.

"Conductometric Control of **Coagulant Dosage** in Treatment Plants." A report of a series of investigations of the kinetics and mechanisms of coagulation of colloids in water using the conductometric technique to make rapid analyses of the rates of coagulation. By Marvin L. Granstrom and S. David Shearer. JAWWA., March, 1958.

"**Water Hammer** Allowances in Pipe Design." A report of Committee 8110 D, Allowances for Water Hammer, presented at the annual conference in Atlantic City, N.J. By S. Logan Kerr, Chairman. JAWWA., March, 1958.

"Progress in **Conversion of Saline Water.**" A discussion of the several potential methods of converting saline waters into fresh water, none of which compete favorably with present methods of water supply and treatment. By Everett D. Howe. JAWWA., March, 1958.

"**Radio-Active Rains** on Surface Water Supplies." Report of analyses on the Iowa River and selected farm ponds show a sharp increase in radioactivity of these surface waters. By R. L. Morris. Water and Sewage Works, March, 1958.



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He says, "When I purchase American Meters, I achieve two advantages, moderate first cost and reduced inventory costs!"

An experienced purchasing executive looks beyond the first cost when he purchases water meters. He must consider parts replacement and repair costs also. American Meters are noted for their simplicity of design. Fewer parts permit more rugged parts, resulting in trouble-free operation year after year. Such service reduces the need for a large parts inventory and lowers maintenance costs.

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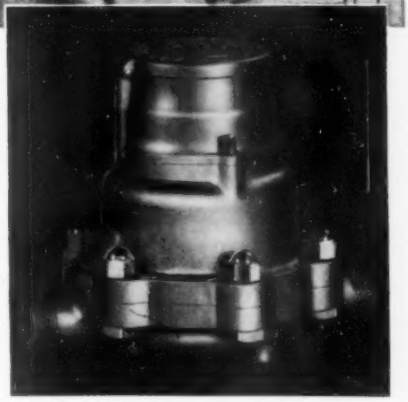

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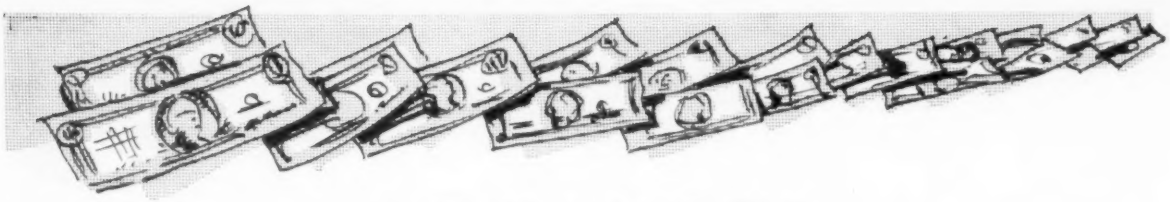

ADVANCES for PUBLIC WORKS PLANNING

JOHN C. HAZELTINE,
Commissioner
Community Facilities Administration,
Housing and Home Finance Agency

COMMUNITIES, counties and urban areas throughout the nation are faced with the problem of expanding population and concurrent need for the construction of public works in almost all categories. This requires basic public works and community facilities to meet the need for new and expanded sources of water supply, for sewerage systems, schools, roads, streets and other facilities. The large-scale needs of the times call for increased public works planning on the part of local public agencies.

A program to encourage municipalities and other local public agencies to maintain a current and adequate reserve of planned public works which can readily be placed under construction was established by the Congress under the Housing Act of 1954, and expanded a year later. Promoting economy and efficiency in planning and building public works is another major purpose of the program, as set forth in the legislation. This Act authorized a $48 million revolving fund, and a total of $17 million has been appropriated for planning work since the beginning of the program. Planning advances under this program are interest-free but are repayable upon start of construction. This provides a revolving fund which permits the utilization of these planning funds again and again to meet local needs.

Many local public agencies unable otherwise to plan ahead for needed community facilities can prepare for such public works as are necessary to support needed housing, industry, renewal and other essential construction. The response to this program by local public bodies and the increasing number of plans being prepared indicate that it is helping to meet an important need in the development of community facilities and in assisting and stabilizing local construction programs.

The continued growth of the reservoir of local public works plans tied to local needs, and the steady repayments of planning advances as projects have gone into construction, show that the revolving fund principle of this program is working, and that the program is providing needed assistance in the solving of specific local public works problems.

Specific Projects

In regard to specific projects, only in large local units is it generally possible to segregate and utilize local funds from annual budgets for advance public works planning. Frequently no local funds exist which may be utilized by many localities for planning prior to the time that authorization for construction expenditures has been voted by the people. Thus, there usually exist costly delays between the inception and development of project plans and the presentation of these in proper form to the voters.

By law, no advance is made with respect to any individual project unless it is expected to be constructed within a reasonable period of time. During the application development stage, personnel of Community Facilities Administration confer with local representatives to establish the probability that the project will meet this condition. In administering the program every effort is made to encourage an active and dynamic reserve of planned public works tied to actual development needs.

Planning advances can cover the cost of engineering and architectural surveys, designs, plans, estimates, working drawings, specifications and other action preliminary to and in preparation for the construction of public works. Both preliminary and final planning are eligible.

Preliminary planning may include all investigations and surveys, such as foundation explorations, test pits, core drilling, water source investigations, both surface and sub-surface, topographic charts and other specific data necessary for determinations upon which a reliable estimate of construction cost can be based. Usually advances are made for complete planning only when the type of project or the conditions under which it is being planned make it obviously impractical to limit the advance to the cost of preliminary planning.

Any non-Federal public agency may request an advance to finance the preparation of plans for any public work it has the legal authority to plan, finance, construct, maintain and operate. Public agencies may include state governments and their agencies, counties, municipalities, towns, townships, school districts, water and sewer districts, irrigation districts, levee districts, special taxing districts, and other types of duly authorized public bodies. Applications must include evidence that the proposed project has been approved by any state or local body whose approval is required by law.

Growing interest in advance planning and the consequent preparation of a reservoir of planned public works is evidenced by the fact that as of January 31, 1958, over 600 communities, counties, and other local public agencies have filed more than 900 applications for advances totalling approximately $25.5 million to plan new public facilities and to replace or modernize obsolete facilities. The estimated cost of the essential facilities represented by these applications is over $1.8 billion. This is in the little more than 3½ years of program operation and the majority of these have been filed in the past year. Over 550 applications, representing planning costs of $13 million and estimated construction cost of approximately

$725 million had been approved as of January 31.

The greater portion of these applications are in the field of sewer and water facilities, approximately 46 percent, with educational facilities approximately 31 percent, and the balance in categories of public buildings, roads and streets, bridges and miscellaneous public facilities.

The significance of this program as a continuing revolving fund and as an incentive for additional public works planning is important. While the total authorization with respect to our overwhelming public works needs may be small, it can, through the careful selection of projects, be used over and over to assist counties and communities with their developmental needs. This can inject a continuous and vital stimulant into the local public works planning process. Thus, in addition to helping with specific projects, it is hoped this program will encourage increased local public works planning on a continuous and over-all basis.

Applications for public works planning assistance are submitted through the Regional Offices of the Housing and Home Finance Agency serving the area in which the project is located. Information and application forms may be obtained from the following regional offices, covering the States listed.

Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont
346 Broadway
New York 13, New York

Delaware, District of Columbia, Maryland, New Jersey, Pennsylvania, Virginia, West Virginia
1004 Widener Building
Chestnut and Juniper Streets
Philadelphia 7, Pennsylvania

Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee
645 Peachtree-Seventh Bldg. N.E.,
Atlanta 23, Georgia

Illinois, Indiana, Iowa, Michigan, Minnesota, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin
Room 2000 Bankers Building
105 West Adams Street
Chicago 3, Illinois

Arkansas, Colorado, Kansas, Louisiana, Missouri, New Mexico, Oklahoma, Texas
Federal Center
300 West Vickery Boulevard
Fort Worth 4, Texas

Idaho, Montana, Oregon, Washington
450 Federal Office Building (Area Office)
909 First Avenue
Seattle 4, Washington

Arizona, California, Nevada, Utah, Wyoming, Alaska, Guam, Hawaii
Flood Building, 3rd Floor
989 Market Street
San Francisco 2, California

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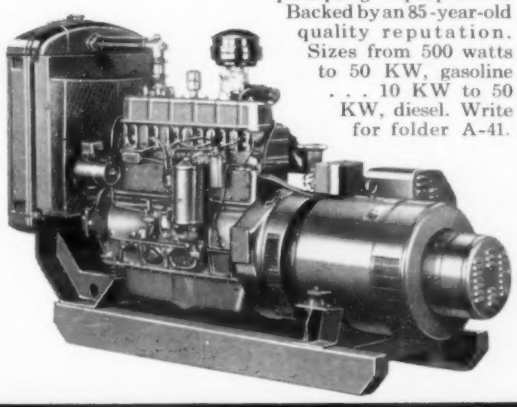

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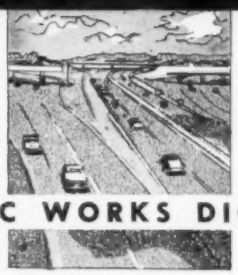


PUBLIC WORKS DIGESTS

Prepared by

FRANK FORCE

Associate Editor

THE HIGHWAY AND AIRPORT DIGEST

County Winter Operations Reviewed

Year-around work must be provided for county highway personnel to have a competent highway force year after year. In Wyoming County, New York, the winter months are just as busy as the summer months. All of the crushed stone used by the department has to be hauled 30 miles, so the material is hauled in the winter and stockpiled. The equipment must be overhauled and this is done by the operators in the cold months. The maintenance men cut trees and brush on next year's construction projects. Also many of the signs have to be taken down, painted, the bullet holes repaired and the signs re-erected. Guide rails and posts must likewise be repaired and painted when the weather permits. The bridge crew makes prestressed concrete bridge members during the winter. When the bridge members are later put in place, the tensioning can be done to tie the members together so that the structure becomes monolithic in effect. Also developed is a precast abutment block which can be tensioned vertically to replace gravity type abutments. The county has the usual snow removal program with plenty of snow.

"Wyoming County Winter Operations Reviewed." By Felix Ramsey, County Supt. of Highways, Wyoming County, N. Y. *Constructioneer*, March 10, 1958.

Highway Indentification Signs Replace Costly Stakes

Painted wood stakes were used originally to identify the state highways in Delaware. Now, new aluminum signs are being installed that designate the maintenance number of all state roads. The maintenance crews are the biggest users of the number system, but the state police, the telephone company and the power and light companies also utilize them. The 5 x 8-in. signs are made of 0.081-gauge aluminum and are tempered for long life. The facing for the aluminum base is a white wide-angle reflecting material. The actual numbers on the signs are made in the sign shop by the silk-screen process and the whole sign is baked as a unit. The large baking oven cooks 84 signs in a batch and baking time is less than 6 min. The signs are bolted to already existing stop signs at the road intersections. The signs, including all material, can be installed for less than $1.50 per sign.

"New Highway Identification Signs Replace Costly Stakes." By R. A. Haber, Chief Engineer, Delaware State Highway Dept. *Better Roads*, March, 1958.

Design and Construction of Concrete Resurfacing

There are two principal reasons for replacing the surface of a concrete pavement: it may no longer be adequate for the loads imposed on it; or its surface may have deteriorated over a period of time and require rehabilitation of appearance and riding quality. In the design of concrete resurfacing projects, thickness, jointing and reinforcement must be considered. In order to design the new surface, the thickness and condition of the existing pavement, the thickness of a new pavement adequate to carry the anticipated loads and the presence or absence of a separating course that would prevent bond or friction between the old pavement and the resurfacing must be determined. Concrete used should be placed with a minimum slump and the steel placed in the same manner as in normal paving when a thick depth of concrete is used. Thin bonded resurfacing should be placed on structurally sound concrete. In construction you must scarify and sweep the existing pavement; joints must be placed over existing joints; construction lane widths should be limited to about 25 ft.; the thickness should be limited to 2 ins.; concrete mix should have the same physical properties as the old pavement; maximum size of aggregate should be ½-in.; and no steel should be used. Quality concrete placed on a well-prepared surface will ensure the satisfactory performance of thin bonded concrete resurfacing, and the long service life, heat-resistance, light reflectance, skid-resistance and other qualities which make concrete necessary or desirable.

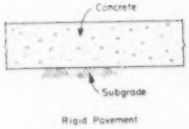
"Design and Construction of Concrete Resurfacing." PUBLIC WORKS, April, 1958.

Perspective Data on Paving Design

The cost of pavement will vary according to the type of subgrade. Flexible pavement will cost from $1.50 to $3.30 per yard depending upon the wheel loading and subgrade, while rigid pavement will cost from $2.50 to $4.00 per yard. The life of a rigid pavement depends on the type of aggregate, the control of grading and placing and type of traffic. For states above the Mason-Dixon Line, if these factors are adverse the concrete pavement will last 15 years. If these factors are favorable the road will last 30-40 years. If the surface becomes rough

Rigid Pavement Thicknesses, Inches

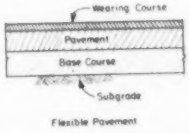
Subgrade Type of Soil	8-Ton Wheel Load	6-Ton Wheel Load	4-Ton Wheel Load
Soft Clay	8.50	7.50	6.00
Sandy Clay	8.25	7.25	5.75
Gravel & Clay	8.00	7.00	5.50
Gravel	7.50	6.50	5.25



Rigid Pavement

Flexible Pavement Thicknesses, Inches

Subgrade Type of Soil	8-Ton Wheel Load	6-Ton Wheel Load	4-Ton Wheel Load
Soft Clay	21.0	18.0	15.5
Sandy Clay	10.5	9.0	8.0
Gravel & Clay	8.0	6.5	5.5
Gravel	7.5	5.5	4.5



Flexible Pavement

Courtesy Consulting Engineer

● **YARDSTICKS for pavement thicknesses for various soils and wheel loadings.**

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a bituminous topping of 1¼ in. binder and 1¼ in. surface of hot asphalt can be applied and can give 15 to 20 years more of life. The life of a flexible pavement is about 20 years. Bad spots can be repaired by using a graded bituminous concrete, spread with a skid or movable screen. An emulsion treatment filled with sand could be used for the entire surface, but this lasts only for several years. Flexible pavements can be used where settlements are expected and they are more suitable for secondary roads because of low first cost. For heavily traveled city streets a concrete pavement covered with 1½-in. asphaltic concrete binder course and a 1½-in. sheet asphalt wearing surface provides a quiet riding surface and can be cut into easily and readily resurfaced.

"Perspective Data on Paving Design." By Elwyn E. Seelye, Seelye Stevenson Value & Knecht. *Consulting Engineer*, March, 1958.

Corrugations on Earth and Gravel Roads

Vehicle design and behavior can influence the growth of corrugations to a marked degree; speed and weight are important factors because increases in both these quantities cause more rapid formation of corrugations. The present methods of maintenance, namely, brushing, dragging and grading, are effective in removing and controlling the growth of corrugations if carried out systematically and regularly. The introduction of modern equipment, principally self-propelled blade graders, has helped in the maintenance of gravel roads. The use of graded base material which resists corrugation has met with great success in Sweden, but more information is required before precise particle-size limits for soils and gravels can be given for construction under tropical conditions. Wide use has been made on secondary roads in the USA of graded soil bases and it is considered that specifications employed on the Florida State Highways might have a useful application in combating the growth of corrugations. The incorporation of cement, lime, road oil, hygroscopic additives and industrial waste products may have beneficial effects but in the case of water-soluble materials the effects are likely to be only temporary. At present the only practical method of eliminating corrugations is the provision of a bituminous surfacing. Surface-dressing has proved a satisfactory form of treatment, but a properly designed base is essential if early failure is to be avoided.

"Corrugations on Earth and Gravel Roads." By J. S. Tanner, B. Sc. (Eng.), Colonial Section, Road Research Laboratory. *Roads and Road Construction*, February, 1958.

Concrete Set Slowed Down To Step Up Bridge Construction

Retarding the set of concrete for 8 or 10 hours speeded completion of the 1,677-ft. Wolcott Ave. bridge over the Connecticut River at Hartford by several months. Keeping the concrete plastic until an entire unit had been placed and all deflection had occurred in the falsework, and then revibrating the entire concrete mass, provided a potentially strong structure for early post-tensioning. This relatively new technique made it possible to cast in place 28 simple spans 120 ft. long in 14½ weeks, using only three sets of falsework. Actually there are 14 spans in the bridge, each about 67 ft. wide and 120 ft. long. Each was constructed in two completely separate parts each 33 ft. 10 in. wide, and the falsework was reset for the second half of each span. The design criteria used for this bridge was the "Criteria for Prestressed Concrete" of the Bureau of Public Roads. The AASHO load-

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With the Anderson's exclusive cutter bar parallel lift, cutting height can be adjusted instantly from ground level to 18" without interfering with mowing. This is made possible by the Anderson system of parallel mounting and unique cylinder action which assures level rise of both inner and outer shoes. The Anderson hydraulic cylinder action also enables the cutter bar to be raised to vertical position to avoid obstacles and then returned to horizontal at the set cutting height with a single control.
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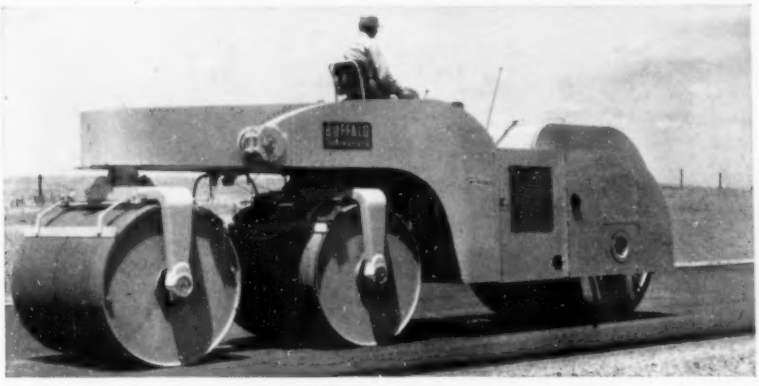

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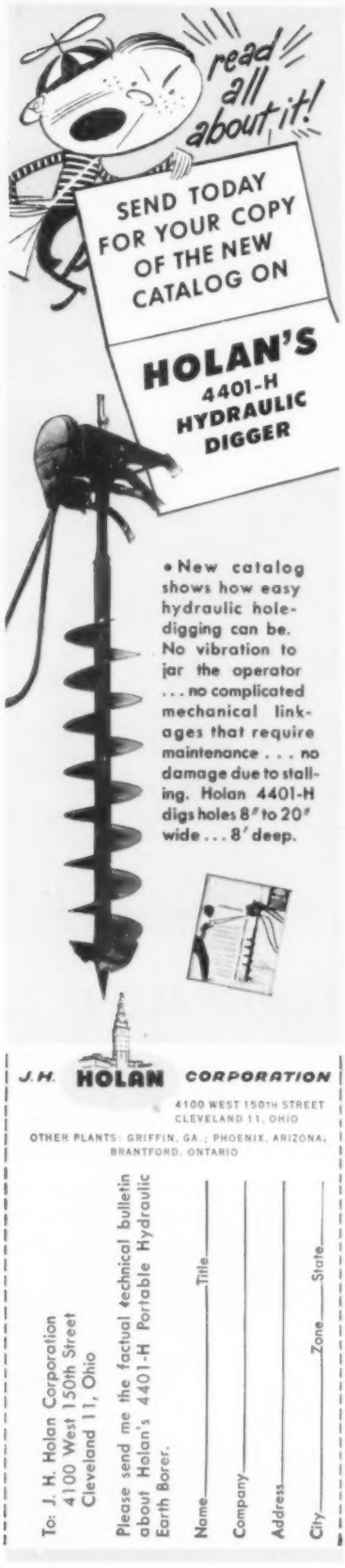
For general asphalt finishing and maintenance, Buffalo-Springfield's two-axle tandems, ranging from 5 to 16 tons, are unequaled for heavy-duty highway and public works projects. There is a right size for every job!

For those smaller jobs, driveways, sidewalks, parking and playground areas, or for patching and light finish work, use the KT-7A, 3-5 ton, or KT-8, 4-6 ton portable tandem rollers. The KT-8 is equipped with hydraulically retractable towing wheels that "fold-away" into the main frame when not in use.

For complete information on all Buffalo-Springfield Rollers and K-45 Kompactor roller, see your nearest Buffalo-Springfield Distributor.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ing is H-20 S13-44. The ultimate strength of this bridge based on a distributor factor of S/5 is 2.2 (dead load + live load), or looking at it another way, 1.0 x dead load + 4.7 x live load.

"Concrete Set Slowed Down to Step Up Bridge Construction." By Gordon C. Linberg, Project Manager, Merritt-Chapman & Scott, Hartford, Conn., and M. Schupack, Vice President and Chief Engineer, The Preload Co., Inc., New York, N. Y. *Civil Engineering*, March, 1958.

Prestressed Concrete Piles

Prestressed concrete piles 3 ft. in diameter, 50 to 90 ft. long and weighing up to 24 tons each were driven at Tacoma, Wash., forming the substructure for reconstruction of the 11th St. Bridge. Post-tensioned reinforcement of the 64 hollow piles consisted of eight 7-wire strands strung through six longitudinal channels left in the 5-in. walls. Wires were tensioned to a total of 700,000 lb. by hydraulic jacks and the ducts grouted. Piles were hauled about a mile to the site, one at a time, using a truck and 6-wheel rear dolly with no intervening support. A heavy-duty skid rig with 90-ft. leads was used in driving the piles. A Northwest 80-D crane assisted in handling the piling. Driving was done with a Vulcan OR hammer, with the ram developing 30,200 ft. lbs. striking average, and with a specially developed cast steel driving helmet for the 36-in. piles. Penetration averaged about 25 ft. Jetting was necessary to help the open-end pile cut through buried debris. Piles were cut off by air-driven chisels using a steel cut-off ring as a guide. Precast cap beams, 31′ x 4′ 6″ x 3′ 2″, with wells for fitting over pile ends were set.

"Large Hollow Prestressed Concrete Piles." *Roads and Streets*, March, 1958.

Performance of Doweled Joints Under Repetitive Loading

Load-transfer systems are desirable in transverse joints of concrete pavements to control edge stresses, to reduce slab deflections under load, and to maintain surface alinement of the two slab ends. In order to develop information on the structural action of load-transfer systems under repetitive loading, the Bureau of Public Roads devised a laboratory procedure quite different from the shear test. The specimen, a concrete slab divided transversely at mid-length by the joint under test, is supported in a machine that applies a known load alternately on either side of the joint for any desired number of cycles. The design of the machine and the dimensions of the specimen made it possible to study, under forces and motions which simulate closely those of actual service, the effects of several variables influencing the structural performance of dowel bars. An analysis of the data developed in the tests revealed that a definite exponential relation exists between dowel diameter and load-transfer capacity, other conditions being constant. A relation was also evident between slab depth and the dowel diameter required to transfer a given percentage of the applied load. This relation indicated that, for minimum dowel size, the diameter in eighths of an inch should approximately equal the slab depth in inches. For $\frac{3}{4}$-in. diameter dowels, an embedded length of 8-dowel diameters is required for maximum load transfer. Larger dowels, such as the 1-in. and $1\frac{1}{4}$-in. diameters now in common use, require for full-load transfer a length of embedment of about 6 diameters, both initially and after many hundreds of thousands of cycles of repetitive loading.

"Performance of Doweled Joints Under Repetitive Loading." By the Div. of Physical Research, Bureau of Public Roads. *Public Roads*, April, 1958.

Problems of Small Bridge Design

For the shortest spans the simplest type of bridge structure is one having a reinforced concrete slab deck that carries load without aid from secondary supporting members. When designed to carry vehicular traffic, the deck may be up to 15 to 18 ins. thick and usually is limited to 35 ft. in length. For spans above 30 ft., prestressing has made concrete competitive with steel under certain conditions. It has extended the effective span of the precast units from 30 to 45 ft., an increase of 50 percent and has permitted a deck type design using deeper sections that can be used on spans up to 70 ft. The most popular type of concrete span in the range of 50 to 100 ft. is one comprised of concrete I-beams, either reinforced for short structures, or prestressed for longer structures. The simplest type of steel structure consists of simple beams or stringers supported at both ends beneath a roadway. There are basically 4 types of piers: The solid; the T-shaped; the isolated column; and the open column cap pier. There are

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3 basic forms of abutments: The gravity wall; cantilever wall; and buttress or counter forted wall. The gravity wall is used up to heights of 18 ft., the cantilever type is good for heights up to 28 ft. and the buttress wall is used where heights exceed 30 ft.

"The Problems of Small Bridge Design." By John B. Mallett, Fay, Spofford & Thorndike, Inc., Consulting Engineers, Boston, Mass. PUBLIC WORKS, April, 1958.

Other Articles

"Mammoth Program Provides Better Streets for Great Falls, Mont." **Street renovation and reconstruction work** includes almost 1000 blocks or one-third the city's area. By A. J. Richardson, City Engineer, Great Falls, Mont. The American City, March, 1958.

"**Design Criteria** for Embedment of Piers." By E. Czerniak, The Fluor Corp., Ltd. Consulting Engineer, March, 1958.

"Machine Placement of Durable **Asphaltic Concrete Curbs.**" By Arthur W. Tews, Chief Engineer, Dept. of Public Works, St. Paul, Minn. Public Works, April, 1958.

"**Bright Lights** For Atlanta." By Guy Browning Arthur. Public Works, April, 1958.

"Nottinghamshire's Big **Road Surfacing Programe.**" Trend towards cold asphalt as a veneer coat. Highways and Bridges and Engineering Works, February 12, 1958.

"Contractors Helped with **Toll Road's First-Year Spring Maintenance.**" Task units made speedy work of ironing out eroded berms after severe early-1957 storms in first spring operation of the Indiana Toll Road. Roads and Streets, March, 1958.

"Recent Research on Some **Problems in the Construction and Maintenance of Roads.**" By Dr. A. R. Lee, Deputy Director, Materials and Construction, British Road Research Laboratory, Dept. of Scientific and Industrial Research. Roads and Road Construction, March, 1958.

• • •

Use of Radioisotopes in Studies of Secondary Sewage Treatment Processes

An extensive investigation of the basic processes of secondary sewage treatment, sponsored by a three-year research grant from the National Institutes of Health, has been undertaken at the Sanitary Engineering Research Laboratory of the University of Florida. Radioactive isotopes are being used as tracer elements to follow the decomposition of complex organic components of sewage in the biochemical changes that take place during the various types and stages of secondary treatment. In this study tagged portions of the principal compounds found in domestic sewage—such as minerals, fats, carbohydrates, and proteins—are being added to the sewage, and the retention times of the radioactive tracers in the various units are being measured. The products of such biochemical decomposition of the basic constituents of sewage during the retention time in each type of treatment unit are detected by complete analyses of samples collected at appropriate times and locations.

These experiments are being conducted on a pilot-plant scale, using to its fullest capacity the present pilot sewage treatment plant which is an integral part of the Sanitary Engineering Research Laboratory. On the basis of the data obtained through this research investigation, attempts are being made to determine the reactions undergone by some of the basic chemical constituents of domestic sewage as they pass through secondary treatment units and are subject to oxidation and stabilization.

In connection with this research, extensive alterations have been made in the laboratory in order to

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Now, something really new, designed to meet the preference of traffic engineers—a mast arm 30 feet long. Here indeed is an added measure of good looks and safety at a cost that compares favorably with span wire. This new arm is both tapered and elliptical, forming a truss design that provides all the strength that's wanted and then some. Set on a 17-foot standard, it offers maximum visibility, yet does not interfere with tele-
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provide shielded space for radioactive measurements and manipulations. A vault has been constructed in the basement for storage of the radioactive isotopes which are being used in this investigation and any other radioactive materials which may be needed as the investigation proceeds. Through the funds provided by this research grant, additional counting equipment and other radioactive measuring instruments have been made available, providing in the Sanitary Engineering Research Laboratory an adequate radioactive laboratory capable of undertaking investigations in the general field of nuclear energy, and particularly in the disposal of waste materials from nuclear-energy installations.

The investigation is under the direction of Professor F. W. Gilcreas. Professor George Morgan is associate investigator. This report was forwarded to us through the courtesy of Professor John E. Kiker.

• • •

Most Useful Equipment

(*Continued from page* 126)

to our 500 or so miles of county road—all of which is gravel surfaced. We added another big improvement when the County bought the John Deere 4-wheel tractor, to which was attached the light Wagner front end loader. We took off the regular closed bucket and in its place attached a "forked shovel"—locally made of discarded light auto axles used as the "tines" of the fork. The new bucket or forked shovel was about 4 feet wide. We windrowed the oversize gravel (which contained some roots and brush), and used the forked shovel loader to pick up the dirt, gravel and brush. It was possible to give the bucket a light jolt or shake during which the smaller acceptable gravel with the loose dirt fell back on the road. The oversized not wanted material was left in the bucket, and was loaded into a waiting 2½ ton dump truck to be hauled away."

"I think our motor patrols and Seaman mixer were used most efficiently and were our most useful machines. They were used continuously during the construction season on bituminous road mix pavement, on stabilized gravel-clay salt bases for the bituminous pavement and on road gravel surfaces stabilized with salt and clay or calcium chloride and clay." This is from Lloyd Nelson, Cass County Engineer, Fargo, N. D.

● **BRIDGE that floated away. Pony truss of Walsh Co., N. D., is upside down and 300 ft. away. See text below.**

"The superstructure of a pony truss bridge floated downstream approximately 300 feet during flood stage in a 1956 spring runoff. The truss was retrieved, dismantled and set back on the concrete abutments by our County Bridge Crew. A 3/4-yd. Koehring dragline was used on this work and I think it is the county's most useful piece of equipment. In 1950, Walsh County had 12 super-

30 FOOT MAST ARM INTERSECTIONS

phone wires. What's more, because this mast arm, as well as the standard, is made entirely of aluminum, it is maintenance-free, keeping its natural trim appearance and good looks for years to come.

CONTROLS 6 LANES

Here is the maximum in visibility for 6 full lanes of traffic . . . good looking, safe, and easy to install.

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structures float down stream during a severe flood in April. Most of these trusses were retrieved and set back on the abutments with the dragline." Harry Schwartz, Walsh County Engineer, Grafton, North Dakota.

"We use a Domor elevator grader on a Caterpillar motor grader and build about 35 miles of road each year. We build most of our mail route roads this way. This," says Ed Noler, Seward County Commissioner, Beaver Crossing, Nebr., "is our most versatile machine."

Sol Kransdorf, Sr. Engr. in Charge—Highway Main., Queens County, Kew Gardens, N. Y., uses "two asphalt plants that manufacture over 120,000 tons of bituminous material and are used to maintain our roadway system. These units are our most useful machines."

Maurice Glockner, Albany Co. Supt. of Highways, Voorheesville, N. Y., says bulldozers were the most effective type of equipment used last year. They were used to push in walls on new construction jobs and then the walls were covered with soil. This eliminated snow drifts in the winter and provided good base material for new highways.

"One of our most useful pieces of equipment is a front-end loader which we shall replace with a new Michigan." B. R. Gebhart, Mercer County Engineer, Celina, Ohio.

North H. Newton, Champaign County Engineer, Urbana, Ohio, likes his two front-end loaders. Caterpillar Models 955, that are used for loading dirt, salt, aggregate, stretching fence, as a movable platform for trimming trees, digging out tree stumps, minor brush clearing and cleaning out some road side ditches.

I. M. Huddleston, Asst. Coos County Engineer, Coquille, Oregon, uses rubber tired front-end loaders for cleaning up flood damage and slides and also on widening projects. One Michigan 2-yd. unit and a Drott 1⅝-yd. unit are his most versatile machines.

M. Gault Beeson, Chairman, Marion County Board of Commissioners, Marion, S. C., uses a truck crane quite extensively. "We used this machine to pick up sections of sidewalk and load same on trucks. This sidewalk was removed easily and could be used as rip-rap and walls elsewhere. We also drove creosote piles, cleaned ditches, loaded trucks and erected steel for buildings with this unit."

"I believe our grading outfit is by far our best equipment" says Kenneth G. Odland, Brookings County Highway Superintendent, Brookings, S. D. This outfit consisted of two Caterpillar D7 tractors and 8 to 11-yard scrapers. There was also one dozer for one of the D7 tractors and an Adams 550 motor grader on this job.

"The equipment that saved us the most time and money was a one-yard tractor-shovel purchased last year. It was used to set concrete pipe culverts and to dig foundations for concrete headwalls for bridges." Clark A. Jacobs, Limestone County Engineer, Groesbeck, Tex.

John H. Pattison, Kitsap County Engineer, Port Orchard, Wash., says that an automatically heated road oil storage tank and plant (capacity about 8,000 bbls.) is his most useful piece of equipment.

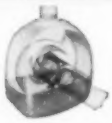
Pat Thompson, Douglas County Engineer, Waterville, Wash., says "our model L75 Pettibone loader probably proved to be the most useful item. We placed it in every type of operation. In the spring it was used to dig in culvert replacements, and load bank material for filling holes. In the summer we used it on ballast hauls and all bituminous projects. In the fall we cleaned ditches, channels and culvert approaches. And in the winter, we added a V plow, and plowed snow with the machine.

These portable pumps prime at 30 feet lift!

These rugged new pumps prime and reprime at lifts up to 30 feet. Move easily because of light in weight aluminum construction.

Four models:

Midget	1½"	6,500 GPH	2.25 HP
Pelican	2"	8,500 GPH	2.75 HP
Hawk	2"	12,000 GPH	5.5 HP
Eagle	3"	18,000 GPH	6.8 HP



Pump at rest—Captured liquid retained for priming. Note no check valve.

Priming action—Entrained air escapes at top to be discharged. Priming liquid returns to entrain more air.

Pumping action—Straight-in suction voids entrance restrictions. Water enters direct to eye of impeller. Sediment is purged.

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Completely sealed, vacuum operation, controlled from cab. Start or stop spread in motion, as at intersections, safety zones. On hydraulic operation models, spot spreading is controlled by by-pass valve.

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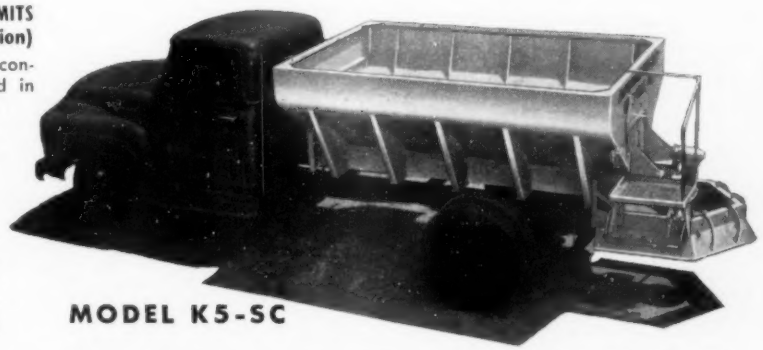

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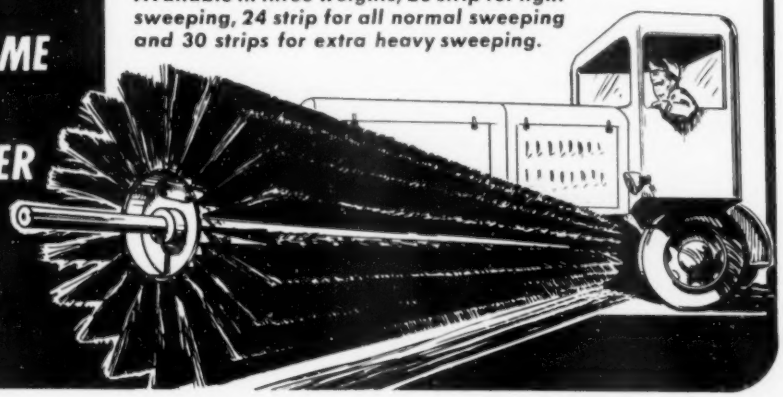

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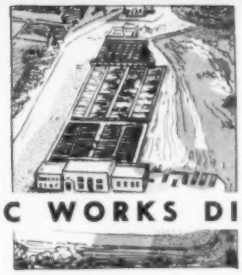


PUBLIC WORKS DIGESTS

Prepared by
ALVIN R. JACOBSON, Ph.D.
Associate Professor and Head,
Division of Sanitary Science,
Columbia University School of Public Health

THE SEWERAGE AND REFUSE DIGEST

Simplifying Activated Sludge Operation

With operating control of the activated sludge process based on a measure of the organic load on the plant and the solids in the aeration tank, there is an unending struggle to keep up with and predict variations in these factors. Therefore, it would be desirable to have a means of describing the operating condition of a plant and controlling its operation without resorting to such analytical determinations as BOD and suspended solids. In previous investigations by Garrett and Sawyer, it was found that the rate of growth of activated sludge is related to the concentration of BOD remaining, and if the growth rate is controlled directly, the effluent BOD and other critical factors can be correspondingly controlled. Growth rate control is made possible by wasting all sludge settled in one or more settling tanks (called excess sludge tanks) and returning all of the sludge from the remainder of the settling tanks. This is effected by controlling the rate of flow of mixed liquor to the excess sludge tank. The rate of return sludge flow is immaterial as long as it is sufficient to remove the sludge from the settling tanks. The method was tested at the Houston, Texas, North Side Sewage Treatment Plant. The operating control procedure was to maintain a constant flow over the weir of the excess sludge settling tank by adjustment of the influent gate. The results were checked by laboratory procedures, and it was found that very good control of the effluent BOD had been provided. A substantially linear relationship was demonstrated between the effluent BOD and the rate of growth, as measured by the ratio of excess mixed liquor flow to the aeration tank volume. The effluent BOD is approximately 25 times the rate of growth, as reciprocal days. This method of operating control may also be applied to modifications of the activated sludge process, such as the Biosorption Process.

"Hydraulic Control of Activated Sludge Growth Rate." By M. T. Garrett, Jr. *Sewage and Industrial Wastes*, March, 1958.

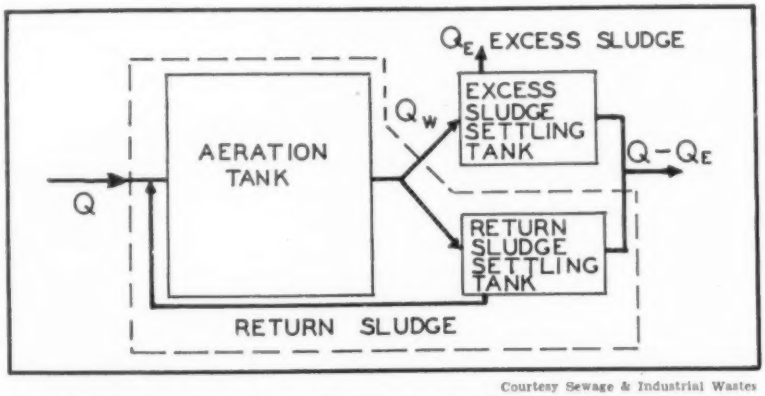
Long Delayed Sewage Project

Conneaut, Ohio completed construction in 1957 of its coordinated sewage interception, pumping, and treatment project that was planned 36 years ago. Apart from City undertakings, a local industry planned and built its plant for the pretreatment of industrial wastes before discharge into the city system. The treatment works were designed for 65% removal of suspended solids under normal conditions by means of pre-aeration and mechanical flocculation, but with an increase to 80% removal by chemical coagulation at periods of low flow in Conneaut Creek. Facilities for digestion, conditioning and dewatering of sludge were also provided. The total capacity of the plant is 2.3 mgd average flow and 4.4 mgd maximum flow. Facilities for chlorination of the plant effluent are provided together with a chlorine contact tank to provide 7 minutes detention. The new intercepting sewer was designed to serve about half of the future population estimated at 20,000 persons. Total length is 7,100 feet, with sizes ranging from 21 to 24 inches. A sewer ordinance was developed to protect sewers and sewage treatment works along the usual pattern by defining a "normal" sewage and prohibiting excessively high BOD wastes and corrosive materials in the sewers. Flammables and materials which cause obstruction in sewers or interference with sewage works operation are also prohibited.

"Conneaut Builds Coordinated Sewage Project 36 Years After First Plan." By William L. Havens. *Wastes Engineering*, March, 1958.

New Incinerator Design

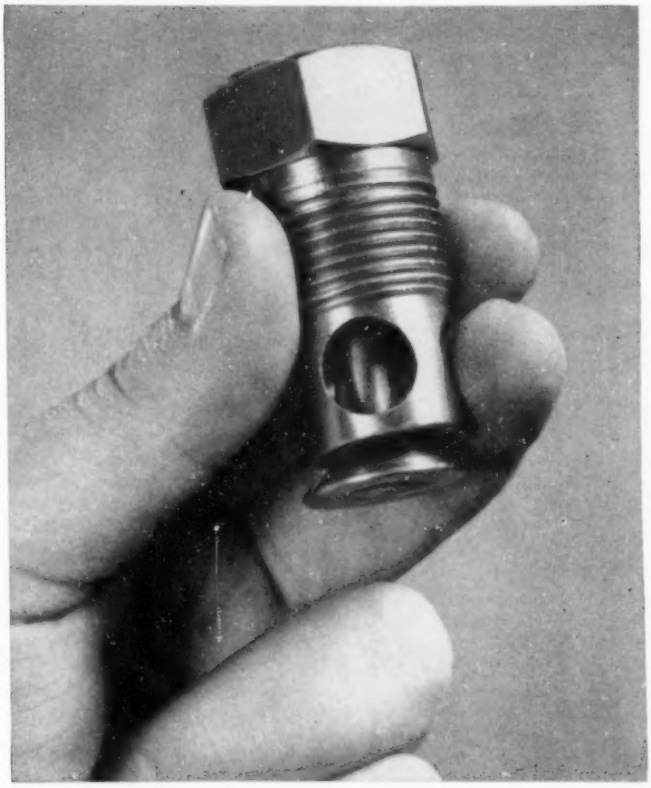
In the 450-ton incinerator now under construction for Hollywood, Fla., extreme care has been taken to eliminate undesirable discharges from the stacks. Separation of fly ash from the inerts, for ease in handling and possible sale, is by means of a wire mesh conveyor and a special solids handling pump. Ash removal from the settling chamber is obtained by a new type of pump. The approximate cost of this 450-ton plant will be $670,000. Furnace temperatures, which will be held at about 1800°F., will be automatically controlled. Underfire air, controlled in three zones, and admitted through cast iron tuyeres built into the burning area of the grate, keeps the fuel bed agitated. The burning gases travel over the bridge wall into the settling chamber, the speed of the gases being kept at a rate low

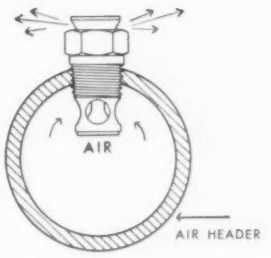


Courtesy Sewage & Industrial Wastes

● **MODIFIED flow sheet showing simplification of activated sludge process control.**

P.F.T. NEW DEVELOPMENTS IN SEWAGE TREATMENT





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enough to prevent excessive fly ash entrainment. The gases next pass through a baffle port; and immediately thereafter are struck by air jets which drive out finer particulate matter. Special waffle blocks pick up the fine materials which have been deposited on the wet bottom. The ash and other inert matter, upon leaving the stoker bed, drop onto a wire mesh conveying belt which moves this material into the overhead storage bin.

"New Incinerator Design to Reduce Fly Ash Emission." By Joseph W. Watson. PUBLIC WORKS, April, 1958.

Sewage Effluent Dilution

Dilution of sewage effluents in sea water has found extensive application in Los Angeles and many other coastal cities of this country. Many of these receiving waters are bordered by extensive bathing beaches. The designer of an installation discharging either chlorinated secondary effluents or effluents of lower grade, should have a general understanding of the phenomena of dilution of sewage effluent in sea water. Knowledge of actual conditions experienced under various conditions is necessary for proper appraisal of the design of existing outlets or diffusers, and for studying the interplay of such parameters as rates of dilution and rates of bacterial decline. The entire process of diffusion of a sewage field and other phenomena that tend to dissipate the pollutants are quite complex. Several formulas and curves have been developed for computing dilutions. Representative profiles of coliform densities and the chlorinity measured about one mile off shore from the Hyperian outfall are shown in this article.

"Sewage Effluent Dilution in Sea Water." By Charles H. Lawrence. *Water and Sewage Works*, March, 1958.

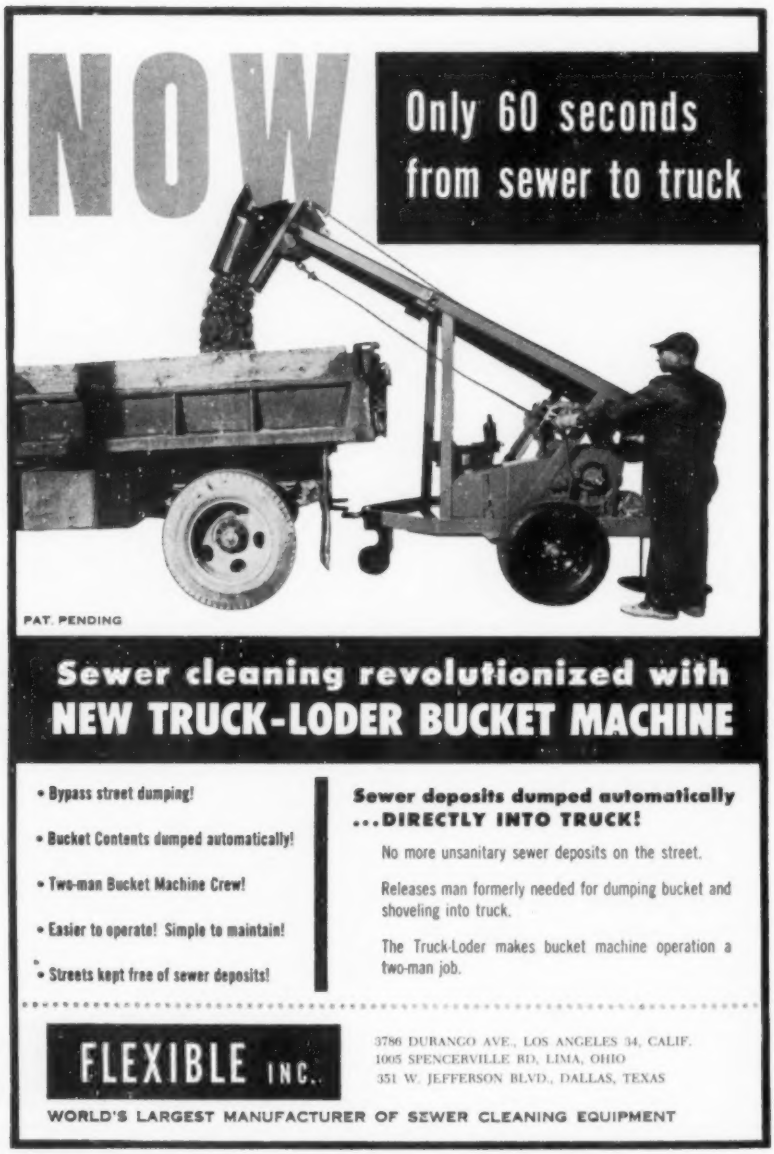
The Biofiltration System

High rate trickling filters of the biofiltration type are those in which some portion of the filter discharge is returned to the influent of the primary sedimentation tank where it joins the raw sewage. The filter discharge may be settled or unsettled, or both, prior to return, depending on the flowsheet used. Biofiltration plants can be designed to provide any degree of treatment between sedimentation and complete treatment. The choice of flowsheet is dependent upon several factors including the strength of the raw sewage, the quality of effluent desired and, to some extent, on the size of the plant. A detailed explanation of use of the various flowsheets is given in this article. When laying out new high rate filter plants, designers need to estimate or predict their performance. This can be done with reasonable confidence through the application of certain formulas developed from analysis of operating data from existing high rate plants. Experience has demonstrated that properly designed, constructed and operated biofiltration plants have little difficulty in obtaining results equal to the calculated performance.

"The Biofiltration System." By R. S. Rankin. PUBLIC WORKS, April, 1958.

Springfield's Refuse Program

The sanitation crews in Springfield, Ill., not only collect garbage and trash, but they also clean alleys, cut weeds, plow snow, and do other jobs connected with the unending job of keeping the city clean. City crews serve the residential areas and private collectors serve the commercial establishments. Each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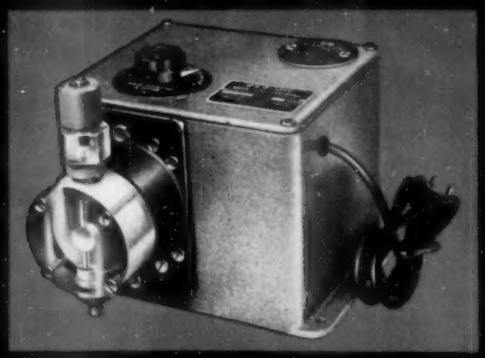

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crew, consisting of a driver and two loaders, makes 600 stops each day. The employees work on an incentive basis with all routes planned for an 8-hour day. Last year the city purchased nine new trucks with 16-yard packer-type bodies. About 90% of the 22,600 homes receiving collection service have alleys. Springfield operates a sanitary landfill. The refuse is well covered at the end of each day, and odors, flies, and rats are a rarity. Operating costs are extremely low, averaging about $12,500 per year. A city garbage tax of $0.059 per $100 valuation is added to the general tax levy to cover the cost of refuse collection and disposal. This amounts to about $6 to $7 per year for the average taxpayer.

"Refuse Collection & Disposal in Springfield, Ill. By Owen J. Darling. *The American City*, March, 1958.

Odor Control in Sewers

Odors in sewage lift stations, sewer lines having flat grades and force mains created problems in Short Hills, Millburn Twp., N.J. During the summer of 1954 and 1955, Cloroben, made by the Cloroben Chemical Corp., was used with excellent results. However, in 1956, another substance with similar characteristics was used in the same manner as with Cloroben but the odors were not controlled and complaints were again heard. Fall and winter brought abatement of the odors and it was hoped that more favorable conditions would result in the early spring of 1957. But odor complaints persisted and in mid-July it was decided to undertake a systematic survey of the affected areas. Sulfide and pH determinations were made throughout the system. Total sulfides of 0.3 ppm and a pH below 7.5 invariably spelled objectionable odors along the lines, but always occurring in specific catch basins and lift stations. The locations where odors were consistently released were pin-pointed on a skeleton map showing the main sewer lines, lift stations, force mains, sampling and dosing stations. On August 7, Cloroben was added at three dosing stations at a dosage of approximately 4 ppm. Results were achieved faster than anticipated or even hoped for. Several days later, being satisfied with the overall results as shown by the reduction in the sulfides to 0.3 ppm the Cloroben dosage was cut to 2 ppm. This reduction resulted in a gradual increase in sulfides but odor control was fully maintained.

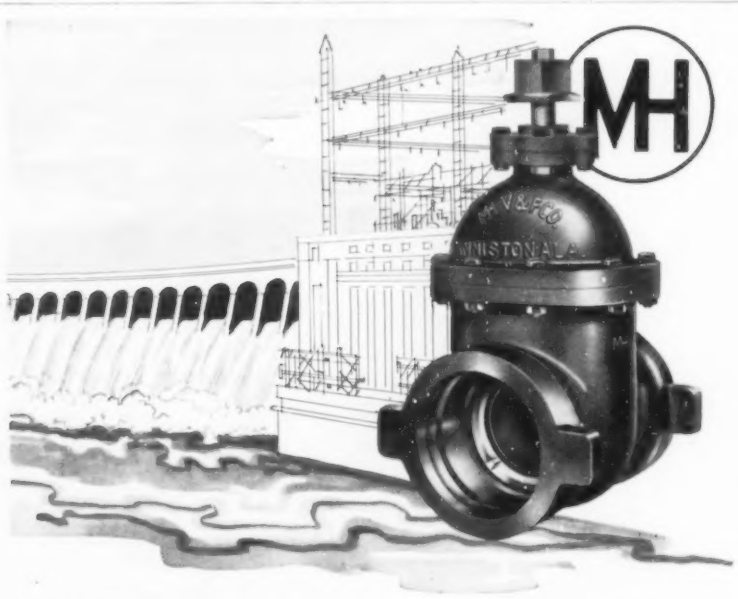
"Experiments With Odor Control in Sewers." By Levi Price and Harold Curran. PUBLIC WORKS, April, 1958.

Other Articles

"Package" and Compact Plants—What Makes Them Click? A report of a panel representing leading manufacturers and suppliers of sewage treatment equipment discussing this and other questions at the New York Sewage and Industrial Wastes Association annual meeting held in New York City. By Kenneth H. Walker. Wastes Engineering, March, 1958.

"Insecticide Resistance." Resistance of insects to DDT and other insecticides indicate that there is an urgent need for increased research if mankind is ever going to win the battle in controlling mosquitoes, lice, fleas, and houseflies that transmit malaria, yellow fever, typhus, plague and many types of dysentry. From a paper by A. W. A. Brown in World Health for June, 1957. Public Works, April, 1958.

"Suburbs Need Public Sewers." This article is based on a report of the Committee of the New York State Public Health Association to study the problem of providing public sewerage in realty subdivisions. The report was presented to the Association at its annual conference in June, 1957 by M. J. Stankewich, Committee Chairman and Assistant Director, Division of Environmental Sanitation, Erie County Health Department. Public Works, April, 1958.



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Water has become a Number 1 problem in the United States. Americans are using water at a greater consumption rate than any other people in history. With population increasing faster than any other nation, it is estimated that by 1975 there will be 227 million Americans—requiring 50% more water than they do today.

Of all our natural resources, water is the one most essential to human existence. Yet water has been one of the least emphasized for research and development. That task now is sponsored by 23 national associations, two of which are American Water Works Association and the Water & Sewage Works Manufacturers Association, Inc., through an agency called The Water Resources Council. It deserves your whole hearted support.

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"Aid for Sewage Treatment Plant Construction." Transfer of some Federal tasks to State and local governments was urged by President Eisenhower and by a Federal-State group appointed by him to study Federal Programs. As might be expected, opposition to this transfer has come from State and local organizations representing municipal activities, fisheries, public health and conservation elements. Public Works, April, 1958.

"Sewer System Maintenance." A report of a study of 45 sewer systems throughout the State of Louisiana made in regards to the type of municipal government, the people of the community, operating personnel, type of organization, availability of financial support and a number of other lesser factors. By James B. Smith. Water and Sewage Works, March, 1958.

• • •

Highway Accident Rates

A recent study indicates four-lane divided highways with complete control of access now in operation in Michigan are almost four times as safe as other trunk highways, but that four-lane divided roads without control of access are the most accident prone and dangerous roads in the state. The Department study indicated an accident rate averaging 151 accidents per 100,000,000 vehicle miles traveled on rural state trunkline expressways as compared to 305 on four-lane divided highways without access control during 1957. The five-year average accident rate on all rural trunklines is 223.

The fatality rate for the same periods was 2.5 per 100,000,000 vehicle miles for controlled access expressways compared with 5 for four-lane divided routes without control of access. The statewide state trunkline five-year fatality average is 8.2.

Phoenix Water Bonds Get "A" Rating

Because of their higher rating, water revenue bonds of Phoenix, Ariz., were sold at an interest rate that will mean an eventual saving of $320,000 to $750,000 on the $16,000,000 issue. Previously rated Baa, the bonds were raised to A rating. In the next few years, $19,000,000 more of the bonds will be sold.

Good Cleaning Reduces Clogged Sewer Basins

A new mechanized basin cleaner with two suction hose reels has reduced the number of choked basins in Richmond, Va., following a rain from a high of 30 to about 4. The older one-reel cleaner operated on only one side of a street, but with two reels, equipment can be operated from either side.

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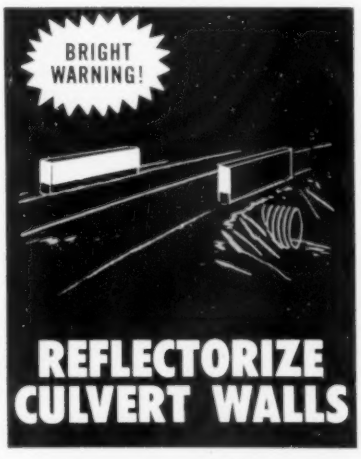

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SEWAGE FLOW CHARACTERISTICS and TREATMENT METHODS *For a Small Community*

ROBERT A. GERBER,

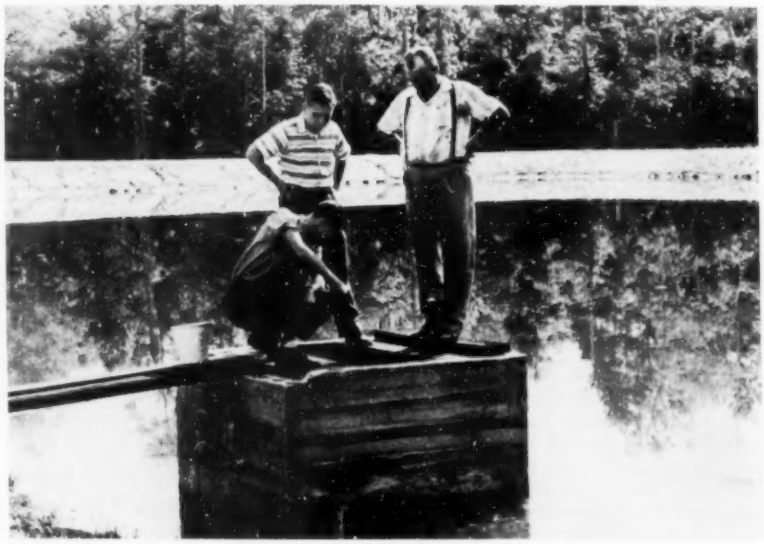
Sanitary Engineer,
Mississippi State Board of Health,
Jackson, Mississippi

A SMALL raw sewage stabilization pond was constructed at Prentiss, Mississippi, and was placed in service in the fall of 1956. The design was along the lines of the Dakota lagoons; that is, with a flat bottom and maximum water depth of five feet. At Prentiss, however, a design loading of 35 pounds of 5-day BOD per acre was used, whereas the Dakota design criterion is one-half that amount. It is believed even this higher loading is conservative, but data are not yet available to support this view fully.

The Prentiss pond is rectangular in shape with a surface area of approximately one acre. The cast iron inlet pipe is supported on piers, and terminates at the center of the pond. The outlet, 100 ft. from the inlet, consists of a square concrete manhole, about eight feet from the water's edge, which is fitted with a tee. A valved drain permits fluctuating the water level. The nearest dwelling is approximately 1,100 feet distant.

Contributors to the pond include seven houses, a 15-room motel, a 30-bed hospital, two garages, three service stations, four stores and two restaurants. Tests were made in February, and in May, 1957, the operational data collected during two 24-hour test periods. Suspended solids determinations deviated from "Standard Methods" and were made by computing the difference in solids before and after filtration through filter paper and by direct determination using a membrane filter.

Flows into the pond during the two test runs were 10.3 and 10.8 gpm and outflow 6.2 and 4.2 gpm. BOD of the raw sewage was 204 and 245 mg/L, and of the effluents 52 and 35 mg/L. BOD loading per acre per day was 25.2 and 31.7 lbs. Raw sewage pH was 6.6 and 7.2 and of the effluent 9.3 and 10.1. Coliform removal was high—96.96 to 99.99 percent. Suspended solids removal was 16.3 percent in February and 96.6 percent in May.



● **MOST OF the Prentiss pond is shown here; outlet in foreground. Left to right are C. E. Moak and J. C. McDonald, State Board of Health, and Mayor A. J. Stamps.**

Flow in the sewer was measured by using a 5-gallon container and a stop watch. Flow was diverted to the 5-gallon container by inserting a 6-inch steel nipple into the 8-inch outfall line. The nipple was caulked in place with jute. To the end of the nipple we attached a portion of a truck tire inner tube. This gave us a flexible pipe, so to speak, and the end of the tube was raised about two feet above the invert so that we could put the 5-gallon container beneath it. I was somewhat worried about what the resulting surcharge would do to our samples since the flow was small. To determine whether we had reasonable figures for BOD and suspended solids, we took four hourly grab samples during the morning periods of high flow from a manhole up the line from the surcharge. There was no substantial difference between these results and the results obtained from the composite sample.

Raw sewage and effluent flows were measured hourly. The minimum flow during the February test period was 2.8 gallons per minute, and the maximum was 30 gallons per minute. The condition of the ground was fairly dry at the time. The weather was clear, and there had been no precipitation for several days before the period of sampling. The 30 gallons per minute flow was measured at 6:30 am. We have no explanation why it should have been so high. It is quite possible, however, that there may have been some small stoppage in the line due to our surcharging and that it cleared itself with the accompanying surge of fairly high flow. It is interesting to note that the measurement made an hour later (7:30 am) showed the flow was only 10.5 gallons per minute. From 7:30 am on, the flow built up to a peak of 18 gallons per minute at 9:30 am.

During the May test the minimum flow recorded was 7.1 gallons per minute, and the maximum flow was 19.5 gallons per minute. The peak flow occurred at 9:00 am. It is my opinion that the minimum flow of 7.1 gallons per minute was in part due to the very wet condition of the ground. Also, it drizzled the afternoon of May 8 and around noon May 9 there was an extremely hard shower. Although only limited data are available, it is my opinion that the flows measured are about normal. The maximum flow during the February test period was approximately 175 percent of the average flow when the 30 gallons per minute flow is excluded, and the maximum

flow during the May test period was approximately 181 percent of the average flow.

Information is not available on the number of hospital beds occupied. However, water pumpage figures during 1955 indicated that the average monthly water consumption was about 150,000 gallons (166 gallons per day per bed). The figures for 1956 were not available because the water meter has been non-operative for a considerable period of time. As I recall, water pumpage figures over the one-year period of 1955 did not show extremes. One of the two restaurants listed as contributors is of no consequence; it is more or less something on the order of a hotdog stand. The other restaurant is connected with a filling station, and the filling station in turn is connected with the motel. This restaurant is quite busy and has a seating capacity of about 50. It is open all night and probably contributes a considerable amount of flow. I have no figures to show the average occupancy of the motel but I believe 75 percent occupancy would be fairly liberal.

The one-acre lagoon is designed for 200 people. Actually, we recommend lagoons be designed for 200 persons or 35 pounds of BOD per acre. However, it is believed that 200 persons in the average small Mississippi community will not contribute 35 pounds of BOD per day. In very many cases no sewer system exists or, if it does exist, no information is available on the strength and volume of sewage, so designers are forced to use a population basis. When the design was first proposed for the installation at Prentiss, we figured about three people for each hospital bed and one person for each of the motel rooms; about 3½ people for each of the houses; and about one or two for each of the garages, service stations, and stores. This left a population equivalent of approximately 75 people remaining for the restaurant. This seemed to be reasonable. At any rate, one acre was as small a lagoon as we wanted constructed. It is our opinion and the opinion of others that larger lagoons will work better than small ones.

On the basis of the pounds of BOD measured during the two test periods, we find the population equivalent during the February period was 148 and during the May period was 187. This was computed by dividing the pounds per acre loading by 0.17. Since the figure of 0.17 pound BOD per capita is higher than we normally obtain, I believe these results are closely equivalent to a population of 200 persons from the average Mississippi small community. Fair and Geyer give figures to indicate that from a strictly residential community, a per capita BOD contribution of about 0.12 pound might be expected. Interesting information along these lines is contained also in the Public Health Service report on lagoon operation in the Dakotas. There the five test towns showed per capita BOD contribution to average somewhere around 0.11 or 0.12 pound per day. In determining a per capita cost for the Prentiss lagoon, I used a figure of 200 persons, and the above serves in part as my justification for doing this.

Evaporation and seepage losses in the pond on February 25 and May 8 amounted to 40 and 61 percent, respectively. Both observations were made during Mississippi's wet season, but the February test period represents winter operation, while the May test period is more suggestive of summer operation. There is reason to believe that pond overflow should stay at a minimum during the hot summer months, and also the pond effluent should not materially increase in BOD concen-

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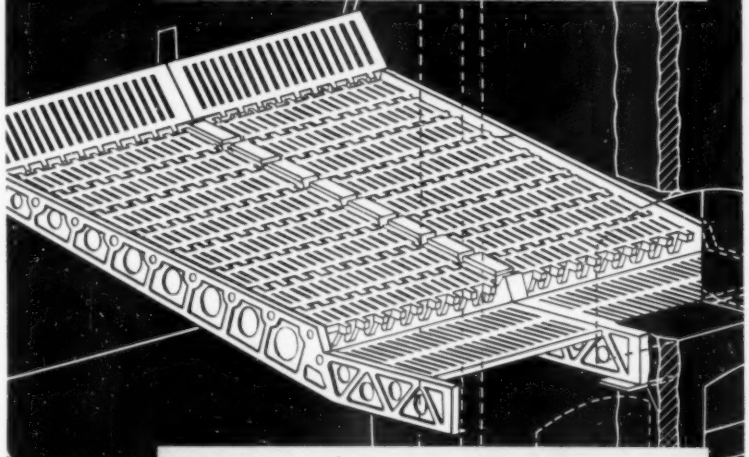

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Dodson's Digest

What's in a name?

John Rhodes invited me to enjoy dinner at his home a few Sundays back, while my wife was visiting relatives in the East. John is a county highway engineer who has labeled most of his friends with nicknames. I was, logically, "Cal."

After a delicious meal which his wife, Sue, had prepared, John and I turned to shop talk.

"Cal," he began, "it's been over a year since you sold me my first carload of Calcium Chloride. I used it for dust control all last summer, and folks still comment on . . . "

"I do the good deed and you take the bows!" I said, kiddingly.

"I guess that's true," he replied. "I do recommend Calcium Chloride to *other* engineers, you know!"

"And I appreciate it! But my toughest sale was getting you to use Calcium Chloride for dust control in the first place," I reminded him.

"Maybe I was slow to learn, Cal," he answered. "Now I know how it can ease both budget and safety situations. I wouldn't be without it."

"When you eliminate chuckholes, keep dust down, prevent loss of material, and offer a harder driving surface," I pointed out, "everybody wins!"

"Cal," he said, changing the subject, "this'll tickle you. The boys on the crew are giving me a new nickname . . . the old one no longer applies."

"That's news to me, John," I smiled. "You've always been one for passing out aliases, but I didn't know *you* had been tagged. What was . . . "

"I'll never tell!" he broke in. "But I'll let you in on the new one when they decide."

Later, after thanking Sue for a fine evening, I asked them over for fried chicken when my wife returned.

"We'd love to!" Sue volunteered. "Chicken is Dusty's favorite!"

— L. D. Dodson

P.S. — For valuable tips on how to solve *your* dust problems with Wyandotte Calcium Chloride, write me for your free copy of our leaflet, "How To Stop Bothersome Dust." *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

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HEADQUARTERS FOR CALCIUM CHLORIDE

tration. The combination, then, of low flow and reasonably constant BOD concentration will result in lower stream loadings at the time of minimum stream flow.

The low costs of construction and maintenance of stabilization ponds are attractive to the small and medium size Mississippi towns. Per capita construction costs range from $28.76 for the one-acre Prentiss pond to $10.28 per capita for a 15-acre pond in Houston, Mississippi. Neither of these costs include pumping station or land costs.

Mississippi ranks 48th in per capita income. This bespeaks the financial plight of the rural community attempting construction of sewage treatment works. Then, too, only about one-half of the Mississippi communities having water supplies have sewage collection systems. In most cases the stumbling block to the construction of collection systems is the additional cost of treatment. Mississippi has some 30 sewage treatment plants that are considered adequate, and during the past two years five plants have been built. Since October, 1956, however, six towns and an Indian school have placed stabilization ponds in operation; six towns and two state institutions have stabilization pond plans either complete or substantially complete; while only two towns and one state institution have planned on constructing sewage treatment plants.

The author is indebted to N. G. McMahon and J. C. McDonald, Chemists, Mississippi State Board of Health, for making most of the analytical determinations reported herein. W. E. Johnson, Consulting Engineer of Jackson, designed the installation.

CLAY PIPE WITH PVC COUPLINGS HANDLES SALT WATER WASTE IN OIL FIELDS

AMONG the problems plaguing many of the country's oil producers is salt water, which frequently is pumped from underground pools together with the oil. Ordinarily the mixture is separated in a settling tank and the salt water discharged into evaporation ponds for natural disposal. In some cases, however, this method runs into trouble when ground seepage from the evaporation pond contaminates underground springs used for domestic water supply.

When such a problem occurred in a Kansas oil field, it was decided to lay a disposal pipe line which would carry the salt waste from the settling tank to a reservoir and finally into an 8-in. steel casing pipe extending 3900 feet below ground level.

Pipeline materials for this project had to handle the highly corrosive salt water and, in addition, withstand a 10 foot head. Salt-glazed vitrified clay sewer pipe equipped with polyvinyl chloride compression type couplings were selected for the job. The pipe, a product of the W. S. Dickey Clay Mfg. Co., Kansas City, Mo., was chosen for its ability to resist the corrosive action of the salt water. The Dicky PVC Coupling, also highly resistant to corrosives, provided the joint permanence and speed of installation the job demanded.

The pipeline system, serving three oil wells, totals 3200 feet. Four-inch feeder lines from the bottom of each of three settling tanks channel the salt water to a six-inch clay pipe lateral line leading through the reservoir to the steel casing.

A trenching machine was used to open the two to four-foot deep ditch. Two men strung and laid the three-foot pipe sections in a matter of a few days. On the last day of the installation 1200 feet of pipe were installed in about six hours. This salt water disposal system is the first of its kind in the area to employ clay pipe and the Dickey PVC Coupling. Contractor for the system was Willis Krell of McPherson, Kansas.

● **UP TO 1200 feet of pipe was installed in six hours by two-man crew.**

This Tractor Shovel Works as an All-Purpose Tool

SINCE THE DAY it was purchased by the town of Wilmington, Mass., a tractor shovel has had its 2-yard bucket in every job undertaken by the Highway Department, which uses this Trojan 154 to load such diverse materials as ledge, boulders, loam and sand, as well as loading bank run gravel. When it becomes necessary to blast the ledge, the tractor shovel handles the 1700-pound blasting mat. During the winter it is used for ice control and snow removal operations. With a Pippin backhoe attachment, it tackles the complete job of installing water mains, although this is done under the direction of the Water Department.

Formerly the installation of water services was accomplished by hiring a small front end loader with backhoe attachment from a private contractor at a cost of $6 an hour. Under the present setup, the Water Department hires the machine from the Highway Department for the same fee, with the money earmarked specifically for the purchase of needed equipment. In two years, money saved on this one operation alone has contributed well over $4,000 to the town's road machinery fund.

Between the two departments, the tractor shovel is kept busy 5 days a week and sometimes even 6. The Water Department points with particular pride to the recent installation of a 6-inch water main from the town's new well. The Trojan-Pippin team was able to dig a 600-foot trench, to a depth of 4 feet and a width of 3 feet, in less than 24 working hours, then laid the pipe, backfilled the trench and compacted the top of the fill. As far as the town officials are concerned, this kind of efficiency packed into one machine is what a community the size of Wilmington demands.

● TRACTOR shovel-backhoe combination completes installation of 6-in. water main.

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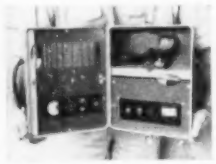

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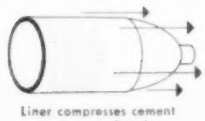
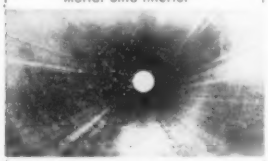


Liner compresses cement mortar onto interior



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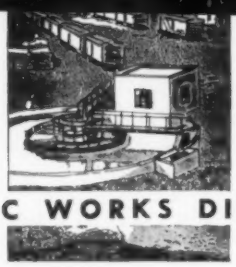


PUBLIC WORKS DIGESTS

Prepared by
CLAYTON H. BILLINGS
Associate Editor

THE INDUSTRIAL WASTE DIGEST

Pulp Mill Waste Problems Summarized

The major sources of liquid waste from a chemical pulp mill, using either the sulfite or Kraft process are the wood room (barking and chipping), the digester building, the bleach plant and the screen room. Re-use can be made of effluents from the screening and machine operations. The effluent from the wood room where a hydraulic log barker is used contains solids, some of which may be removed by screening. The suspended solids remaining are most effectively removed by lagooning or settling. BOD varies from 450 to 2700 lb. per mg. The waste liquors from the digestion process are characterized by toxic properties and high BOD values, which may be reduced by treatment or recovery. Effluents from the Kraft process will have effluent BOD values about one-tenth those from the sulfite process. The bleaching plant wastes are highly colored and cause foaming. The white water from the paper-making machine may be recovered. The pollutional characteristics for wastes from the entire pulp mill, per ton of pulp are 50-1,500 lbs. of BOD, 15-180 lbs. of volatile suspended solids, and 260 to 4,000 lbs. of total solids, for the sulfite process. Where the Kraft process is used, these values are, respectively, 60-200 lbs., 15-200 lbs., and 250-1,000 lbs. Investigations by the Washington State Department of Fisheries have shown that waste liquor concentrations as low as 13 ppm, if continuously subjected to Olympia oysters, could cause mortalities among the oysters up to 20 percent. Threshold mortality indices for chinook and pink salmon are 500 to 600 ppm of sulfite waste liquor during 30 days' continuous exposure. Abnormal growths of slime fungus occur in very low sulfite waste concentrations, 25 to 100 ppm. In the absence of adequate methods of recovery or utilization of the wastes, it has been the practice of the Washington Pollution Control Commission to permit the use of deep water diffuser lines, and in one instance a lagoon, as temporary abatement measures.

"Pulp and Paper Mill Wastes in Washington." By Alfred T. Neale, Washington Pollution Control Commission. *Industrial Wastes.* March-April, 1958.

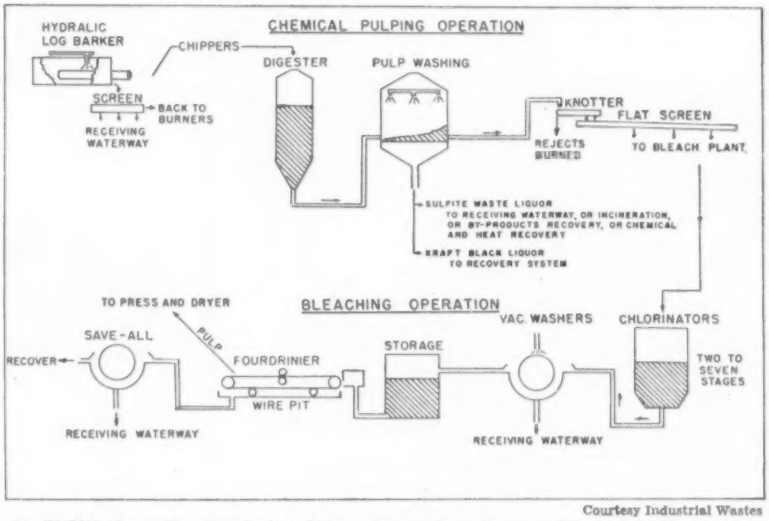
Evaluation of Fluoride Emission Control

Even though there are many installations for absorbing gaseous fluorides and particulate fluorides to avoid their discharge to the atmosphere, not much data have been published concerning power requirements and performance. Absorption of sulfur dioxide is analagous in many respects to the absorption of gaseous fluorides and equipment performance should be relatively similar. On grid towers, height is the controlling factor and liquid and gas phase power use is not significant. The performance of cyclone spray scrubbers and spray towers is dependent on power expended in the liquid phase and is independent of power expended on the gas phase. The reverse is true in the case of Venturi scrubbers. The performance of spray towers absorbing silicon tetrafluoride is not consistent with simple gas absorption, possibly because of mist formation in the tower. In handling fine fluoride fumes, power consumption for removal of particles by liquid scrubbers is far greater than for absorption of gaseous fluorides.

"Performance of Equipment for Control of Fluoride Emissions." By K. E. Lunde, Stanford Research Institute. *Industrial and Engineering Chemistry*, March, 1958.

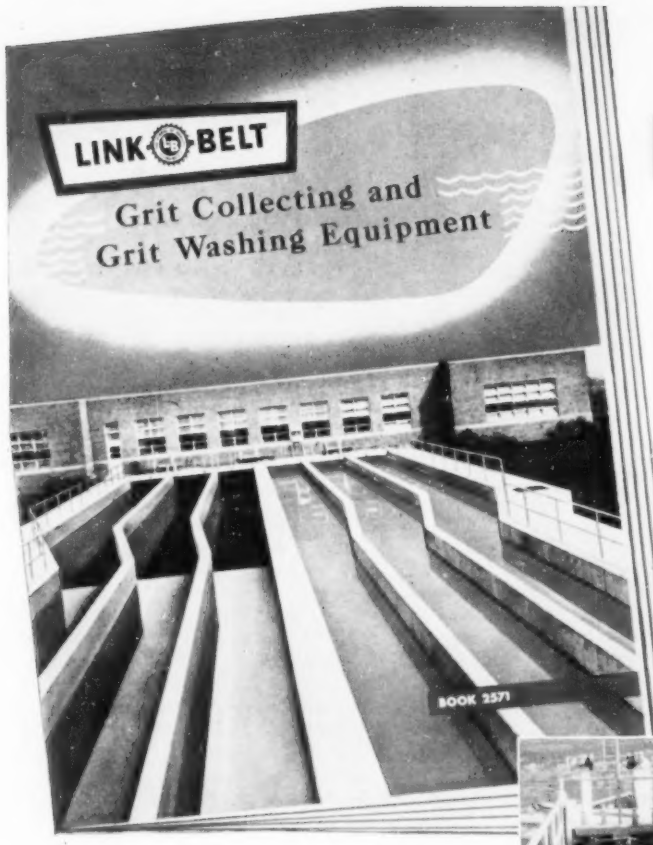
Radioactive Waste Disposal Methods

Airborne wastes include particles of radioactive material originating from failure of a fuel element in an air-cooled reactor, particulates from iodine and fuel processing plants and from plutonium fabrication facilities. Special high-efficiency filters and iodine gas removal units are employed. Air used as a coolant for a reactor is prefiltered to remove particles which would become radioactive when irradiated. Combustible solid wastes may be burned and noncombustibles buried or packaged for ocean disposal. Exclusive of packaging, burial costs have ranged from $1.52 to $9.40 per cu. yd.; incineration costs, $1.60 per cu. ft. Low level liquid wastes are those approaching in radioactivity the tolerance of hu-



Courtesy Industrial Wastes

● **FLOW sheet for chemical pulping process from logs to finished plant product.**



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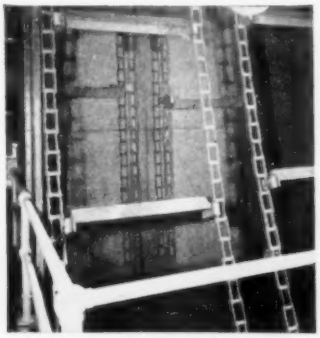
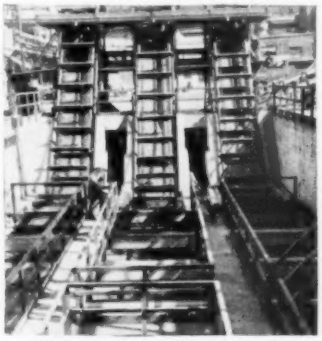
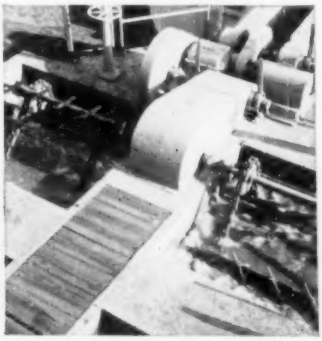
TYPE S — This chain and pitched flight Straightline grit collector is designed for shallow channels . . . discharges grit to washing and dewatering screw at influent end of chamber.



TYPE B Straightline grit collector is ideal for deep channels. It consists of either a single or double strand collector with buckets that elevate grit to washing and dewatering screw.



TYPES IH AND IM Straightline grit collectors economically remove inorganic solids or sewage grit where no washing is desired. Flights dewater material as it is elevated to discharge point.



TYPES AB, AS, AND ASB Straightline aerated grit collectors use compressed air to create and maintain velocities which produce optimum conditions for separating solids at all flows.

mans. High level and intermediate level waste radioactivity is such that shielding is required. Low level wastes are most frequently released to the environment and may include residues following recovery of uranium ore, cooling water from reactors, and wastes from laboratories where radioactive materials are used. Plans are under way at the Oak Ridge National Laboratory to construct a treatment plant for removal of strontium among other radioactive elements, using either phosphate coagulation or lime-soda ash softening. In Great Britain, formulas have been developed for determining when treatment is sufficient to permit discharge of wastes to streams. In ocean disposal, the minimum depth used in this country is 1000 fathoms, half that required by Great Britain.

"Atomic Energy Program, for Waste Disposal (Part I)." By Conrad P. Straub, R. A. Taft Sanitary Engineering Center. *Industrial Wastes*, March-April, 1958.

Bioassay Procedures For Toxic Wastes

The bioassay provides a direct approach to the problem of toxicity of wastes to aquatic life, yielding information on the toxicity of a particular waste in a particular receiving water. In fish toxicity investigations, the result is reported as the 24-, 48-, or 96-hr. median tolerance limit (TL_m); that is, the concentration of the waste which kills one-half the test fish in 24, 48, or 96 hrs. Among the factors which may influence the toxicity of a waste are temperature, dissolved oxygen, CO_2, pH, alkalinity, hardness, and wastes or other materials already in the receiving water. In general, materials are more toxic at high temperatures and at low dissolved oxygen levels. Alkalinity and hardness may determine the toxicity of heavy metals through precipitation, complexation, or buffering action. Even small changes in pH can alter the toxicity of ammonia, the metals, metallo-cyanide complexes, and some weak acids. The presence of carbon dioxide affects pH and thereby changes the toxicity of some materials. Continuous flow bioassays can serve as a monitoring means to detect any unusual toxicity due to spills or the release of wastes from certain processes during short periods. Bioassays can be helpful to pollution control agencies in determining if a particular plant should be located on a given stream. They will be of value in apportioning stream use equitably among various industries according to the toxicity of their total waste and for detecting violations of regulations.

"Disposal of Toxic Wastes." By C. M. Tarzwell, R. A. Taft Sanitary Engineering Center. *Industrial Wastes*, March-April, 1958.

Fumes and Dust from Rubber Reclaiming

Since its construction, Plant No. 2 of the U. S. Rubber Reclaiming Co. in the suburban Buffalo town of Cheektowaga had been troubled with fumes released from rubber hydrocarbons and reclaiming oils used in the reclamation of rubber from old tires. The fumes penetrated the atmosphere for a distance of 2 to 3 miles. After unsuccessful attempts at control, the plant installed a small pilot model of a special wet system of precipitation engineered and built by the Johnson-March Corporation. Its success led to the installation of three full-size 3,000-cfm units. Known as the Type A Hydro Precipitator Scrubber, the unit consists essentially of a rectangular-shaped housing containing a plenum chamber for reducing gas velocity and wetting the entrained particles, a multiple tube section for compressing the gas at

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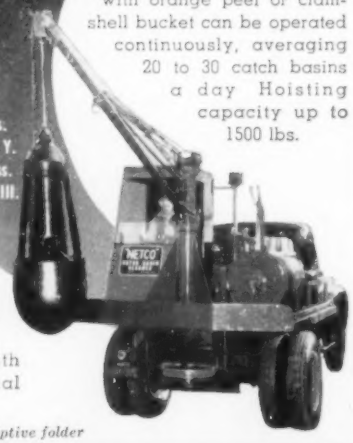

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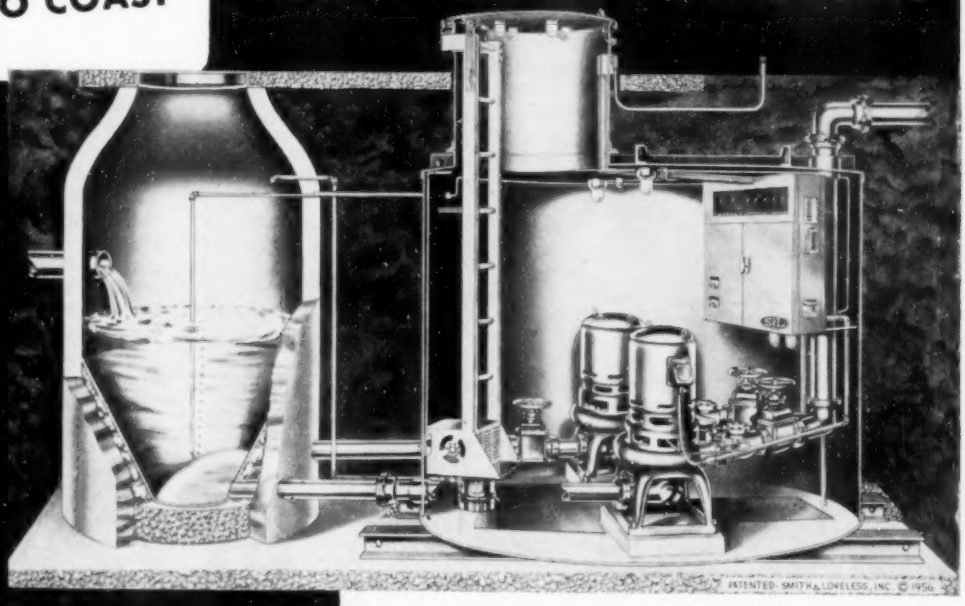

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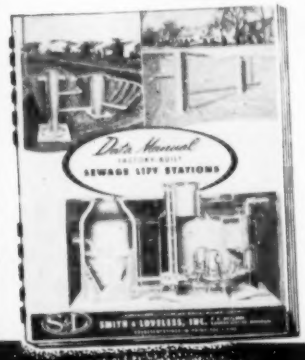

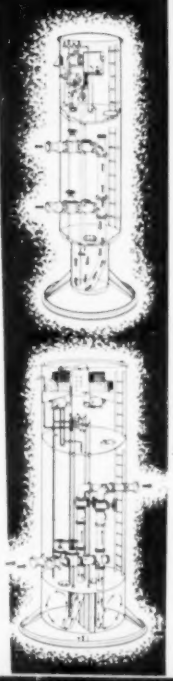

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high velocities upon flowing into a water tank, and a gas-dewatering filter. Tests have shown that the Johnson-March scrubbers are better than 99 percent effective in the removal of fumes and 98 percent efficient in the abatement of microscopic dust. The units also have minimized the danger of fire and eliminated the chances of explosion.

"Industrial Odor Problem—Solved." By John C. Quinlan, City of Buffalo Dept. of Public Works. *American City*, March, 1958.

Other Articles

"Air Pollution Control Law." By Raymond W. Hess. As in the evolution of the New York State air pollution control law, a law can be developed by cooperative effort. Industrial Wastes, March-April, 1958.

"Smoke and Soot Problem." Another installation of the Johnson-March Type A Hydro Precipitator Scrubber provides the answer, this time for a scrap metal reclaiming industry. Industrial Wastes, March-April, 1958.

"Chemicals Recovery from **Pulping Liquors."** By Donald F. Othmer, Polytechnic Institute of Brooklyn. Recovering acetic and formic acids from neutral sulfite semichemical pulp process liquors would help reduce stream pollution and could provide sales revenue. Industrial and Engineering Chemistry, March, 1958.

GRAVEL STABILIZATION WITH TAR

I. RAY GEER,
County Superintendent of Highways,
Lewis County, N. Y.

LOCATED in upstate New York, Lewis County lies in the Adirondack foothills. The prevailing winds come from Canada over the eastern Great Lakes, placing us in a heavy snow-belt; the season snowfall often reaches 200 inches. We also get periods of extreme cold weather when the temperature drops to —40°F. Frost has been driven down in our roads to a depth of 5 feet. We must build our roads with deep, well drained sub-bases and water-resistant bases to protect them from the seasonal effects of frost-heaving.

The traffic problem is not so much a matter of numbers, as it is of heavy trucking. To meet these conditions, one of my chief problems is to reconstruct nearly 200 miles of our county road system which either has reached—or soon will reach—an advanced stage of obsolescence. Our present program is geared to the policy of re-designing these roads to high standards insofar as curvature, grades, and sub-base courses are concerned. We then build the stabilized base and wearing surface by stage construction.

In our County, sand and gravel are more economically available than crushed stone. Stone is thus used only in the surface or wearing course, while gravel is used in sub-base and stabilized base construction. We require that this gravel consist of hard, durable particles, free from shale, and so graded with proportions of coarse and fine particles so that it will not segregate. The available gravel deposits do not, of course, always meet these requirements. They vary in quality and grading, especially in the amount and size of the oversize boulders. For this reason, Lewis County purchased a portable gravel plant to screen out and crush the oversize to a more desirable and useful size. The County has no laboratory or testing facilities, but can run screen analyses on aggregates.

Gravel for sub-base is processed to a 3-inch top size. It is placed and compacted to a minimum depth of 15 inches, and to a standard width of 24 feet. This sub-base course is usually placed one year, then

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opened to traffic until the next construction season, when the stabilized base and surface course are constructed.

Gravel for the stabilized base course is processed to meet the following approximate sieve analysis: 100 percent passing 1½-in.; 60 percent passing ¾-in.; and 20 percent passing ¼-in. The processed gravel is hauled to the job site, tailgated over the previously constructed sub-base, and spread by blade grader to a loose depth of 5 inches, and a width of 20 feet. This is equivalent to 1630 cubic yards per mile. Average gravel plant capacity is about 200 cubic yards per day, so the gravel is usually processed in advance and stockpiled until needed. After placing, and before stabilizing this gravel course, traffic may compact it to a considerable degree. Except when applying tar, the road is never closed to traffic.

Just prior to starting the tar stabilization, the base course is blended by a Pulvi-Mixer or rotary tiller travel mixer, to correct any segregation and to loosen the gravel. RT-6 road tar at 150°F is then applied to the loosened gravel through a distributor at the rate of 0.6 gallon psy. This is then cut in with the Pulvi-Mixer, with tines set to a depth of 4 inches. As soon as this is uniformly mixed—two to four passes of the mixer—a second shot of the same grade of tar is applied at the same rate of 0.6 gallon psy. Mixing is continued until all the tar is thoroughly blended—another two to four passes of the Pulvi-Mixer. The finished mix has a uniform chocolate brown color, rather than black. Just sufficient tar is used to stabilize the gravel, rather than bind the particles together, as in a plant mix surface course. Thus the finished mix is lean in appearance and mealy in texture. It is readily shaped to uniform depth and desired cross-section by means of a blade grader. Compaction is obtained with a 10- to 12-ton three-wheel or tandem steel roller.

Our projects have been about 4 miles long. It is our usual practice to break these down into one mile sections for mixing and spreading. Based on experience, we plan to mix a one-mile stretch on a given day; then we lay it out and compact it the next day.

The laying out and compaction need not be rushed when using tar, since there is no critical point when it will "set". On each project we select a level section of road adjacent to the project and prepare a sufficient quantity of this tar-stabil-

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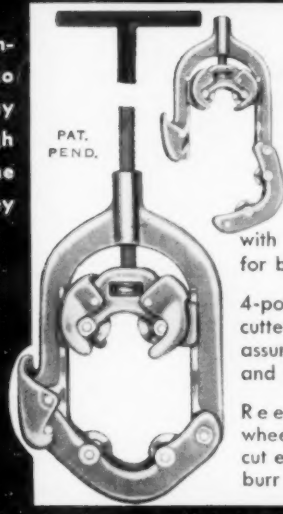

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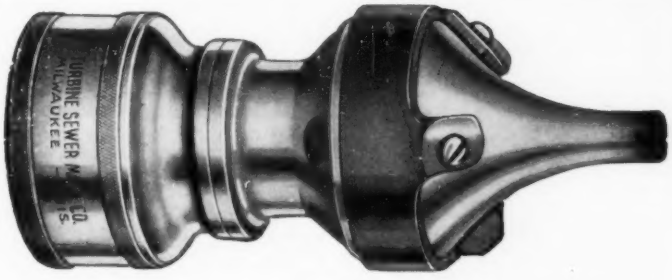

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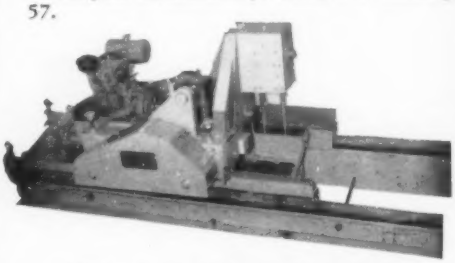

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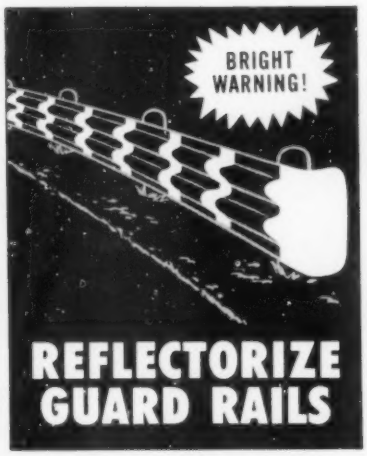

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ized mix to place at intersections where mixing in place would not be practical.

After initial compaction, we apply a tack coat consisting of 0.25 gallon psy of the same grade of tar as used in the mix. If required, a small amount of sand cover is applied to blot up any excess and prevent pick-up by traffic. Traffic is permitted on the road at all times except during application of tar and the first pass of the Pulvi-Mixer. In fact, after mixing and laying out, regular traffic will assist in final compaction, and does not tend to shove or whip off this mix.

We now have a dense and well-stabilized course of gravel with a uniform depth of 3 inches. However, it is not designed to withstand the abrasion, suction, and pounding of heavy truck traffic. After two to four weeks, when this stabilized course assumes a finished appearance, a wearing surface is applied. For this course, tar grade RT-8 is usually applied at the rate of 0.3 gallon psy, and covered with 15 or 20 pounds psy of ¼-in. to ⅛-in. stone chips. We have also used RC-4 asphalt cut-back applied at the rate of 0.3 or 0.4 gallon psy with the same amount of cover stone, with good results as a wearing surface.

Cost for this type of construction will vary in different regions. The principal factors, of course, are cost of gravel at source and cost of processing. Good results may be obtained using selected bank-run gravel, where the gradation is not too variable.

We chose tar for gravel stabilization for the following reasons: 1) Moisture content of the gravel used is not a critical factor; 2) tar does an excellent job of quickly coating all particles, especially the fines, without balls or clods; 3) binding and waterproofing properties of tar produce a dense stable course which when laid over a well drained, granular sub-base, eliminates the frost heaving; and 4) this construction can be accomplished with regular road equipment and crews.

This paper was presented at the ARBA Convention in Washington, D. C., and has been slightly condensed here.

• • •

Unified Highway Sign Program For Connecticut Toll Road

More than one million dollars worth of all-aluminum highway signs, supporting structures, and road markers are being constructed

in the largest single, unified highway sign program in the nation designed to make the new 129-mile, $460 million Connecticut Toll Road one of the safest and most clearly marked turnpikes in America.

Some 4,000 dark blue and dark green signs with reflective letters, and employing a number of highway sign advances, will guide motorists on the new highway, and its many interchanges and four-leaf clover intersections. About 3,000 two-piece trailblazers, distinctive emblems with arrows which point the way to the superhighway along its feeder roads are also on order. In addition, 12,000 delineators—small silver and amber-colored prismatic "cat's eyes"—will clearly mark the shoulders of the roadway and all curves and intersections.

Federal Sign and Signal Corporation is constructing and erecting all of the signs and supporting structures under contract with the Connecticut State Highway Department.

A number of highway sign advances incorporated in the Connecticut Toll Road program include extensive use of interlocking aluminum extrusions developed by Federal engineers to provide maximum strength and durability. About 440 of the signs employ a new type of special reflective sheeting on the background which multiplies the ability of the entire sign to catch the eye of motorists traveling at high speeds. Some 330 brightly illuminated fluorescent signs installed on 110 overhead steel spans and 87 cantilevers will help direct traffic at toll booths and special interchanges.

• • •

Don't Ignore Soils Studies

(*Continued from page* 119)

Compressible layers located at greater depths are not stressed and the possibility of future settlement occurring is not measured. The results of such tests should consider area-perimeter ratios.

Pile load tests usually measure the capacity of a single pile alone to support a given load. Here again, interpretation of the results is very important. An individual pile load test will not establish the behavior of a pile group, nor will it take into account the long-time settlement of a friction pile in clay. Soil investigations are indispensable in equating the results of such a pile load test to the over-all problem. It can only be stated that the most difficult and costly part of a building to repair is the foundation. Therefore, the funds appropriated for a soil study represent money well spent.

WHAT'S NEW IN SOILS STABILIZATION

DR. T. WILLIAM LAMBE,
Director of Soil Stabilization Laboratory and Associate Professor, Dept. of Civil and Sanitary Eng., Massachusetts Institute of Technology

CONSIDERABLE use has been made of chemicals to alter or control soil properties: for example, lime, calcium chloride and sodium chloride have been used to treat surface soils; and sodium silicate has been injected into buried soil strata.

A number of factors—increased construction volume, more severe load conditions, and growing shortages of select soils and building sites—have greatly extended and intensified the interest in and need for soil stabilization. Chemicals are

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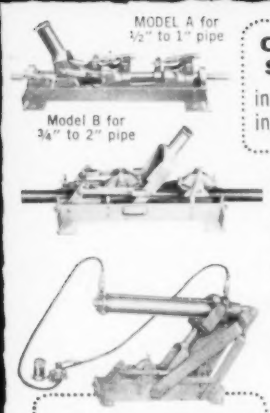

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particularly interesting since there are so many available which will alter soil properties. For example, the following soil properties can be either increased or decreased with chemicals: Permeability, compressibility, water sensitivity and frost susceptibility.

The primary limitation to the use of chemicals to treat soils is economics. Since techniques of soil stabilization are considered only when soils existing at a sit. are not entirely acceptable in their present state, economic considerations are of controlling stature. Large scale stabilization must be cheaper than other techniques, such as replacing the unsuitable soil with a more satisfactory one, as gravel or crushed stone. For wide use as a soil stabilizer, a chemical must be cheap or be effective at very low concentrations, e.g., below 1 percent of the soil dry weight.

Since trace-chemical stabilization depends upon the manipulation of soil and reactions of water and/or chemicals with soil, soil cannot be considered an inert filler. Exploitation of trace-chemical soil stabilization has necessitated research into the chemistry and physics of soil particles. Many of the recent and important developments in chemical soil stabilization have, therefore, actually been in the areas of soil mineralogy and soil structure.

Trace chemicals which react with the soil can produce modest but significant changes in those soils containing some particles finer than 0.074 mm. These effective trace chemicals employ one or more of the following three mechanisms: dispersion, aggregation and waterproofing.

Recent research has shown that dispersants can reduce the permeability of soils. For example, the permeability of coarse, dirty sands may be reduced as much as 1/200 of the value of the untreated soil. Practical use has been made of this permeability reduction by adding dispersants to fine-grained soils to form liners for reservoirs or cores for dams.

Laboratory tests have shown that a few tenths of a percent of a dispersant can effect a significant reduction in the frostheave of dirty sands and gravels. A field test on the use of these dispersants has shown that the beneficial performance indicated by laboratory tests was obtained in the field.

Laboratory tests and limited field tests have shown that trace quantities of aggregants, dispersants or waterproofers can increase the stability of soil as much as 4 and 5

fold. The tests have shown the following materials to be among those with promise: Alkyl dimethyl benzyl ammonium chloride, polyacrylates, ferric chloride and the polyphosphates. The economic outlook on the polyphosphates and the ferric chloride is good since both materials are relatively cheap.

The well known stabilizers, asphalt and portland cement, have a proven record of good performance where used properly. Additives which would increase the effectiveness of these two stabilizers would, therefore, be useful. Recent research has shown that trace chemicals can effect important increases in strength of both soil-asphalt and soil-cement. Among the most effective additives to improve soil-asphalt is phosphorous pentoxide. This chemical has increased the strength of a silt-asphalt by 4-fold.

A number of materials which can increase the strength of soil-cement have been found. Some of these such as sodium chloride and sodium sulfite are inexpensive additives; chemical treatment at less than 1 percent of the soil weight has increased up to 3-fold the strength of soil plus 5 percent cement.

Recent years have seen considerable research in the area of chemical injection. A result of this research is the development of an injection technique employing the *in situ* polymerization of acrylate monomers. Since this technique possesses several advantages over other methods of injection, it has been used in the field at an increasing rate.

Application of Aerial Photographic Interpretation To Engineering Soils Studies

D. R. LUEDER,
Manager,
Hunting Technical Services, Inc.
Columbus, Ohio

THE COMPARATIVELY new technique of Aerial Photographic Interpretation (API) is of tremendous value in the completion of reconnaissance and preliminary soil-rock-drainage studies for engineering projects involving the construction of roads, railways, pipelines, canals, bridges, dams, airports, large building projects, subdivisions, urban extension and water-supply developments.

API should not be confused with photogrammetry, photo-reading, or

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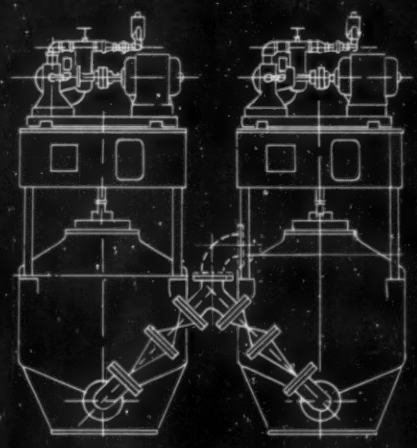

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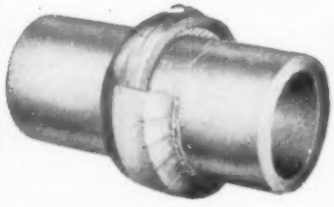

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photo-analysis. It is quite distinct from the first and is more advanced than the latter two techniques. It includes all the elements assigned to photo-reading and analysis, but imposes three additional criteria: the invariable use of the stereoscope; careful examination of all elements of the airphoto pattern; and deductive-inductive evaluation of these elements in terms of common sense, logic and experience, supported by the interpreter's technical and practical background.

API reveals qualitative information regarding the land. Included in this category are location, origin, and general texture of various soils and unconsolidated deposits; location and general evaluation of sand, gravel, clay and boulder deposits; origin, type and structural characteristics of bedrock; delineation of areas having good internal drainage, imperfect drainage and waterlogging; delineation and typing of surface drainage; location of areas having very shallow or variable overburden; general classification of overburden depths indication of adverse conditions such as springs, seepage, landslides, high water table, faults and joints, high salinity and high erosive potential; and selective location of areas for subsequent field checking, drilling, sampling and ground geophysical investigation.

There is no aspect of engineering involving relatively large areas of land surface, which cannot benefit materially from reliable advance knowledge concerning the above characteristics for the area being studied.

In initial stages aerial photographic techniques, by themselves, provide reliable or indicative information on all the desired elements. In later and more detailed stages of the study where field work is necessary, the techniques can be used to preplan the field survey so that it will be most efficient. By preplanning, that 90 percent of the area giving 10 percent of the trouble can be subjected to 10 percent of the field effort, while the remaining 10 percent of the area giving most of the trouble can be concentrated upon in advance or possibly avoided. When survey and soils crews are sent to the field, they can check, plan layout and sample in possession of extensive and pertinent information about terrain conditions and their probable effects.

The applications of interpretation are many and varied to imaginative but prudent engineers, and particularly to those interested in efficiency. However, the technique should be used with full knowledge of its own

advantages and disadvantages. Advantages include: lack of climatic restrictions; lack of restrictions due to inaccessibility; flexibility; and speed. In addition, the overall perspective provided by the photographs allows the detection and evaluation of many features that are actually undetectable on the ground. These are seen not in one view or aspect, but as they actually occur in relation to their surroundings. An occasional disadvantage is seasonal and climatic restrictions on new photography. Usually, existing photography can be substituted, limitations upon use are, in some cases, dense foliage, poor scale and poor photographic quality.

Denver Sewerage Study

(*Continued from page* 98)

gree of treatment for sewage wastes and comparable treatment for industrial wastes is of paramount importance. Clear Creek is used as a supplemental source of domestic water supply for Arvada, The Consolidated Water Company and Westminster, and provides all of the water used by Baker. These all have water treatment plants. The effluents from six sewage treatment plants reach the Westminster and Baker water intakes.

The natural stream flow of Clear Creek is affected by numerous factors including transmountain diversions, storage reservoirs, irrigation diversions, returned irrigation flow, municipal water supply withdrawals, precipitation within the watershed, and discharge of treated sewage and industrial wastes. A study of all of these factors showed that the hazards associated with partially treated sewage contained in domestic water supply have increased greatly in the past few years. With anticipated population growth and in the absence of corrective measures, these hazards undoubtedly will be increased even more. Recent bacteriological analyses of the treated water produced at Arvada, Baker and Westminster indicate that for significant periods of time the water was unsafe. Odor complaints have been made by users of the Baker supply and difficulties in treatment have been experienced here and at other plants using Clear Creek as a raw water source. Detergents difficult to remove in sewage treatment works have been regarded as important factors in odor complaints and treatment problems at these water purification plants.

Denver has supplied water to surrounding communities as far as the capacity of its supply would permit. The area within which such service is extended is circumscribed by what is called the "blue line." Heavy demands now made on the Denver supply prohibit extension of the "blue line" to serve new areas until after 1962. This is the year in which authorities expect completion of the present expansion program which will greatly enlarge the capacity of the Denver water supply.

Development Plans

Development plan studies were made for the Clear Creek basin, the Thornton-South Adams County area, and the South Platte-Big Dry Creek area. When combined with proposals recommended for the City and County of Denver they form the basis for the Metropolitan Basic Plan. For each of these areas cost studies were made of a variety of plans providing sewage collection and treatment. Three general types of plans were investigated: (1) all existing sewage treatment plants were to be retained and expanded as needed; (2) a trunk sewer was to be constructed to convey all wastes to a single enlarged treatment plant with all other treatment

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plants immediately abandoned; and (3) several variations of plan (2) in which portions of the trunk sewer were to be initially constructed and some plants initially abandoned with others operated only until major repairs or improvements were necessary and then abandoned. Plant operating costs were also considered and two development stages were studied for each plan.

Basic Plan

Integration of the various sewage collection and treatment works under a single Authority is considered to be the most feasible solution for the Metropolitan Denver area. There are many benefits which can accrue through such a proposed consolidation, some monetary, and some, though less tangible perhaps of even greater importance. Some of the more important benefits are as follows:

Per Capita Costs. Technical literature has repeatedly shown that per capita operating costs for small plants greatly exceed those for large plants. Data obtained in the Denver area bears this out. Annual per capita operating costs in 1956 for two small primary treatment plants in the area with a capacity less than 2000 were $3.60 and $4.50 respectively. Annual per capita operating costs for the City of Denver plant serving 550,000 people with primary treatment, were $0.62 in 1956. Over a period of years, substantial savings in operating costs are realized at such large plants. Moreover, their design and location permit economical expansion when future loadings require it, a feature which often proves very difficult in many small plants.

Similar data on construction costs show per capita costs which are relatively the same—high for plants serving small populations, considerably less for plants serving large populations.

An excellent example of construction and operational cost benefits derived from consolidation of facilities is shown in the Clear Creek Development Plan. Over a twenty-three year period an estimated 1.7 million dollars would be saved by integrating the sewage collection and treatment facilities within this watershed. Additional cost benefits would accrue through better equipment maintenance and lowered depreciation resulting from better operation afforded by more highly trained and experienced personnel who can be obtained for larger treatment works. Cost benefits derived from the Clear Creek Development Plan are typical of similar benefits which can be expected if consolidation of sewerage facilities is carried out in other watersheds.

Operational Features. Unless it is carefully and intelligently operated, a sewage treatment works may accomplish little in treating the wastes for which it was built. Effective operation is dependent to a great measure upon the competency of the operational staff. It is virtually impossible to staff small sewage treatment works with highly trained, competent supervisory personnel who are so important in obtaining maximum utilization of sewage treatment facilities.

Adequate laboratory facilities are also important to make necessary physical, chemical and bacteriological tests. The cost of laboratory facilities for small plants is so prohibitive that they are rarely provided; at large plants this cost is relatively minor and consequently large plants are usually equipped with fine laboratories.

Public Health. Due to the factors described, many of the plants in the Denver area are not satisfactorily operated and produce poor effluents. The resulting improperly treated sewage has, in various places, caused nuisances and imposed a public health hazard on municipal water supplies. Partially treated sewage discharged to dry ditches has resulted in odor nuisances and a health hazard.

Other Considerations. Integration of existing and proposed sewage collection and treatment facilities within Metropolitan Denver under a Metropolitan Sewerage Authority would reduce the number of municipal sewage treatment plants from 21 to 4. All of the minor watershed subdivisions would be under one over-riding administrative control. Under this plan all sewer extensions, including lateral systems would be subject to approval by the Authority. Maintenance of trunks and the operation and maintenance of treatment plants would be the responsibility of the Authority.

The proposed consolidation of sewerage facilities would bring up a number of legal and financial problems. That such problems are not too difficult to solve is proven by the existence of a number of such Metropolitan Sewerage Authorities throughout the United States. Similar Authorities can also be found in Germany along the Rhine River.

Because these problems might delay the complete integration rec-

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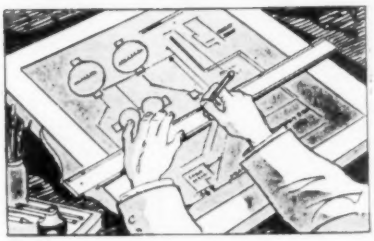

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ommended under the Metropolitan Sewerage Authority, several alternative plans could be followed. In general these alternatives permit consolidation of small watershed areas into Authorities and later integration of these Authorities into the Metropolitan Authority.

Basic Plan Costs. Estimated construction costs of proposed facilities are as follows. For trunk sewers: The Sand Creek Trunk sewer $739,000 and the first stage of the Big Dry Creek sewer sized to carry Littleton's sewage $1,126,000. For trunk sewers, plus sewage treatment works, the first stage costs for Clear Creek is estimated at $5,830,000 and for the first stage of Thornton-South Adams Co., $1,306,000. Additional treatment plant costs for the 85-mgd north side improvements are estimated at $8,517,000; and for the Englewood expansion, including trunk sewer, force main and lift station, $7,172,000. These basic plan costs total $24,690,000.

Engineering Design of Municipal WATER SUPPLY RESERVOIRS

VERNON H. ROSEBRAUGH,
Department of Civil Engineering,
Engineering Experiment Station,
Kansas State College

THIS STUDY was made to devise an empirical method of determining design criteria for small surface water supply reservoirs. The Engineering Experiment Station of Kansas State College sponsored the project which had as its aim the determination of the apparent inadequacies of reservoir water supplies for municipalities of Kansas during drought periods and the development of criteria to guide future design.

Minimum design characteristics for surface water supply installations were determined on an empirical basis by analyzing existing supplies. Numerical values for volume of storage and area of watershed for adequate and inadequate supplies were noted and correlated in computing the minimum requirements. Minimum design values for storage volume and drainage area were determined as 125,000 adjusted gallons and 2.25 adjusted acres per person using water.

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In computing adjusted volumes and areas, the actual storage volume in gallons and drainage area in acres were multiplied by the ratio of the average annual rainfall for the location divided by 40. Thus if the average rainfall were 32 ins., the multiplicand would be $32 \div 40$. The figure 40 was used in the computations to express the ratio in terms of the maximum average rainfall for the area in which the investigated reservoirs were located.

The four principal features in reservoir performance: Population served, area of watershed, volume of storage, and annual rainfall were correlated in an expression:

$$K' = \frac{0.5\ A + 10\ V}{2P}$$

Where K' = the derived factor
A = the adjusted drainage area in acres
V = the adjusted reservoir volume in millions of gallons
P = the population served

Where reservoir installations were deficient in either storage volume or drainage area, an excess in the other feature could partially compensate for the deficiency. This compensating effect was thus taken care of by the expression for the K' factor. A value for K' of 1.2 was recommended as a minimum design value. The K' factor was intended to be used as a basis for comparison between proposed and existing reservoirs.

The computed minimum values should not be used blindly but rather as guides for engineering judgment. They represent values which have been found to be satisfactory for reservoirs in eastern Kansas over the past two or three decades.

An unexpectedly large increase in water consumption has occurred. The normal city dweller has been using 160 gallons per day in recent years, an increase of 60 percent in the last 20 years. The recent municipal use of water in Kansas has been 155 gallons per day per capita, slightly less than the National average, but still six times as much as the rural citizen used. Washing machines, air conditioners, lawn watering, and all the conveniences associated with city living have contributed to the rise in water consumption. There has been no recent development to indicate that the rate of use of this important commodity will not continue to rise.

The silting of reservoirs has resulted in a decrease in the effective

volume of storage. The deposition of silt in reservoirs has increased materially in recent years due to increased cultivation of land in reservoir watersheds. As a result of siltation studies, cities have reported reductions of storage volume up to 50 percent of the original capacity.

The effect of evaporation has probably been underestimated. It has not been unusual to have five or six feet of evaporation loss during a dry year. This loss has been equal to half of the average reservoir depth in many cases. Since dry spells have usually been accompanied by hot weather and sunshine, the effect of evaporation has tended to increase the shortage problem materially.

Seepage losses have been very difficult to evaluate, and have been appreciable in many installations. Many of the reservoirs were built about 20 years ago in the days of WPA. The designs often were less than the best and engineering data for dams in the area were not available at that time. Evidence has been found to indicate that excessive seepage losses have resulted, some to the point of having caused partial structural failure. It has been necessary to include seepage losses with evaporation losses in analyses of installations in most cases.

All of the factors influencing the construction of storage reservoirs have tended to make them very expensive. In addition to the cost of the structures involved, the pools themselves covered many acres which resulted in a loss of considerable tillable land in the reservoir areas. Since many of the reservoirs were constructed during a time in which funds were difficult to obtain, many cities probably built the biggest dams they could afford and hoped for the best.

Of the cities in Kansas which have depended entirely upon storage of surface runoff for their water supplies, 70 percent had to curtail water use during the three years immediately preceding June, 1955. This curtailment of water use generally took the form of restriction of lawn watering and car washing. However, in the case of two cities in eastern Kansas, it became necessary to haul water to supplement the city supply. This hauling of water entailed a great deal of expense and inconvenience.

This material appeared in Engineering Experiment Station Bulletin 80, available from Kansas State College, Manhattan, Kansas.

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PUBLIC WORKS
EQUIPMENT NEWS

Sewer Cleaner of Radically New Design

Hand shovelling is out with this unit

Hand shovelling and unsanitary sewer deposits on city streets are eliminated by the new Truck-Loder bucket machine just announced by Flexible. The completely new design makes it possible to back up a truck directly under the dumping end of the machine. It is said that simplicity of operation makes the unit easier to operate than conventional bucket machines, so that deposits can be brought from sewer to truck in a matter of 60 seconds. Since a helper is no longer needed to dump the bucket or shovel deposits into the truck, cleaning with bucket machines is now a two man operation. For more details write Flexible, Inc., 3786 Durango Ave., Los Angeles 37, Calif., or circle **No. 5-1** on the reply card.

LGP-30 Electronic Computer

The Royal McBee LGP-30 electronic computer is 26 ins. deep, 33 ins. high and 44 ins. long, exclusive of typewriter and shelf. It is mounted on casters for mobility and operates from an 110-volt outlet. The memory drum capacity is 4096 words and the word length is 32 bits including sign and spacer bit. As standard equipment, an electric typewriter keyboard allows manual input of both alphabetic and numerical data with a speed of 10 characters per sec. For more data write Royal McBee Corp., Westchester Ave., Port Chester, N. Y., or circle **No. 5-2** on the reply card.

Jaw-Action Bucket Improves Loader Performance

Now available from the M-B Corp. is a heavy duty truck loader with a versatile self-loading bucket incorporating a hydraulically operated jaw. The jaw swings down and reaches out to meet ground level approximately 13 inches forward of the lip of the bucket. Smoothly completing its closing cycle, the jaw pulls in and holds the full load bite in the ½-yd. bucket. The jaw action of the self-loading bucket eliminates the necessity of ramming the truck into a stockpile to obtain a full bucket. When picking up small piles, the jaw fills the bucket quickly, easily and completely without chasing the material along the street and without using additional men to sweep or shovel into the bucket. The loader is designed to fit almost all types of trucks, including four-wheel drive units, cab-over, tilt cab

Capacity of the bucket is ½ cubic yard

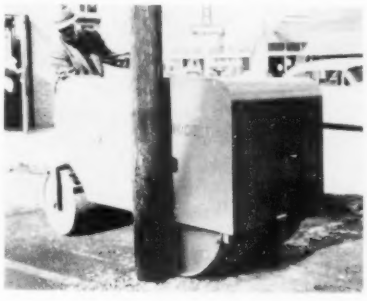
and conventional trucks, without violating legal overall truck width restrictions. It is ideal for sweeper pile pick-up, sand and gravel operations, removing excess spoil, leaf pick-up, snow removal, and street and highway maintenance. Complete information is available from M-B Corp., New Holstein, Wisconsin, or circle **No. 5-3** on the reply card.

Morrison Model 900C Service Body

Extensive improvements for added convenience and more economical maintenance on their new Model 9000C service truck body are announced by Morrison Steel Products. New paddle locks on all doors are completely serviceable in the field using only pliers; and combine one-hand operation with a safety-type catch which prevents a partly-closed door from opening accidentally. Major components such as side boxes, bulkheads and floor, are now bolted for easy knock-down. The floor is of special bridge-girder construction for extra rigidity. The six compartments are all newly sized to take standardized packaging units; shelves of the front vertical compartments are fully adjustable, and left-hand horizontal compartments have full-length tool trays with reinforced rolled edges, providing easy access with no sharp edges or corners. Complete information is available from Service Body Div., Morrison Steel Products, Inc., 601 Amherst St., Buffalo, N. Y., or circle **No. 5-4** on the reply card.

Roller Operates Within ½-Inch Of Buildings, Curbs and Posts

The Gledhill Road Machinery Co. has announced a roller that is designed to operate within ½-inch of almost any obstacle. This roller is an invaluable piece of utility equipment for municipalities, highway departments and general contractors. It has single lever control with constant mesh transmission and the unit is powered by a Wisconsin 9.2-hp air-cooled type engine. When completely water filled the drive roll exerts 85 pounds pressure per lineal inch and the steering roll 30 pounds per lineal inch. Overall length of roller is 86 ins. and the width is 41 ins. It works at speeds of ½ to 2 mph and has a 120-gallon sprinkler tank. For additional information write to The Gledhill Road Machinery Co., Galion, Ohio, or circle **No. 5-5** on the reply card.



Street Sweeper With Leaf Broom Attachment

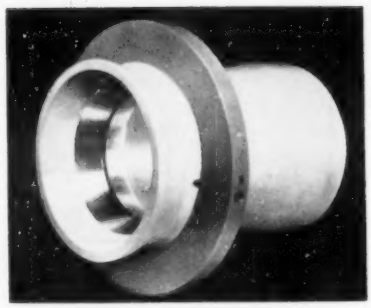
The Model 60 motor sweeper available from Austin-Western has a new leaf broom attachment. The hopper has a capacity of 5 cu. yds. and the gutter broom can be operated right or left or both right and left hand. The spray system tank has a capacity of 210 gallons and the water pump has a capacity of 25 gallons per minute. More details from Austin-Western, Construction Equipment Div., Baldwin-Lima-Hamilton Corp., Aurora, Ill., or circle **No. 5-6** on the reply card.

Curing Membrane for Concrete

Crete-Cure, a white pigmented concrete curing membrane having high dispersion characteristics has been developed by Thiem Products. In Crete-Cure, the compounded particles of materials are dispersed, or given greater suspension. The result is a heat reflecting concrete curing agent that offers the maximum in moisture retention, is of more uniform consistence, flows freely and is less apt to clog or contaminate spraying equipment. For further information, write Thiem Products, Inc., 9800 West Rogers Street, Milwaukee 19, Wisc., or circle **No. 5-7** on the reply card.

Plastic Lightweight Dall Flow Tube

A compact, plastic, insert-type Dall Flow Tube, Model DFT-PI, has been announced by Builders-Providence. It is made of epoxy or polyester resins, reinforced with fiberglas, with corrosion-resistant metallic throat-ring and flange. This flexible differential producer is ideally suited for metering ordinary liquids, gases and slurries, with very low head loss and consequent reduced pumping cost. The Model DFT-PI fits between pipe flanges, and its extremely short length and light weight make it especially easy to install. Accuracy is within ±1 percent of actual flow rate for uncalibrated units, and can be increased to ±½ percent by laboratory calibration. Standard models are available with a variety of metallic materials, and for pH from 0.2 to 10. Temperature ranges are from —60° to 220°F. For further information write to Builders-Providence, Inc., 345 Harris Ave., Providence 1, R. I., or circle **No. 5-9** on the reply card.



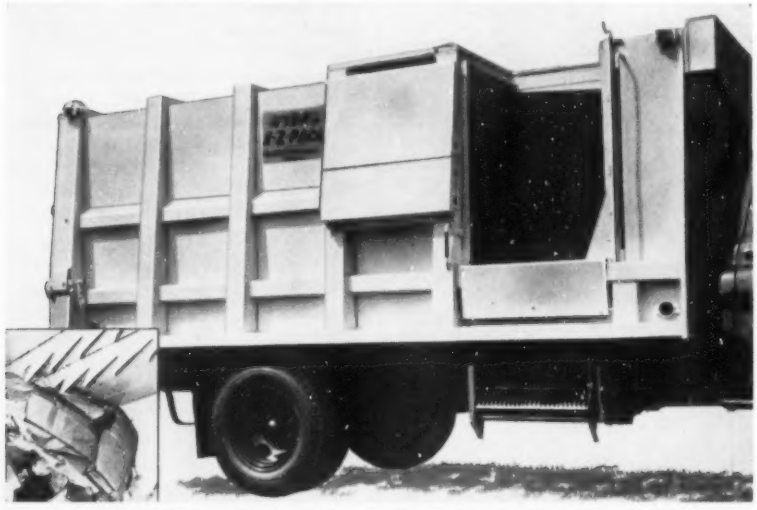
Tube is made of epoxy or polyester resins and is reinforced with fiberglas

Industrial Mower Announced By Minneapolis-Moline

A new side-mounted industrial mower with exclusive MM close-coupled drive, hydraulic controls, high cutting speed, simplicity of mounting, and 135° cutting angle is announced by Minneapolis-Moline as the Model SO industrial mower. Mounted on the side of the tractor, the new SO mower permits full visibility of the cutter bar, and cuts right up to the edge of the rear wheel tire track. Cutter bars are available in 5, 6 and 7-ft. sizes. An ultra-short pitman, 1 15/16 inches long, together with a new oscillating arm between the pitman disc and the cutter bar helps reduce vibration. Independent hydraulic control of both the height and the angle of the cutter bar is provided by two double - acting cylinders. Steel springs counterbalance the mower weight, and lessen down pressure and wear on the high-carbon inner and outer shoes. The springs also allow the cutter bar to float along the contour of the ground. For safety of the operator and protection of the mower, a spring-loaded break-back disengages the cutter bar drive, allowing the bar to swing back 45° when obstructions are encountered. For full data write Minneapolis-Moline Co., P. O. Box 1050, Minneapolis 1, Minn., or circle **No. 5-10** on the reply card.

Packer-Type Garbage and Refuse Body

A new packer-type garbage and refuse body has been announced by Hydro E-Z Pack Division. The new models will feature two saw-tooth retainer bars extending the length of the cab roof, which hold the packed load in place after the packer plate has been withdrawn, keeping the loading area clear and reducing the number of strokes of the platen. Other engineering features include an obstruction-free floor, complete watertight body, two-side loading and greater compaction pressure. The unit is available in standard sizes of 16, 20, and 24 cubic yards. For further information write Hercules Galion Products, Inc., Galion, Ohio, or circle **No. 5-8** on the reply card.



Body does not lift to unload and is completely watertight with two-side loading

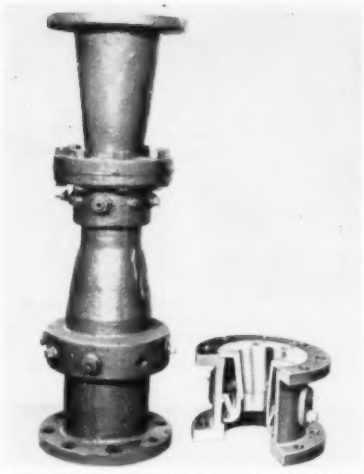
Homelite Generator

Two new 3,000 watt, gasoline-engine-driven generators specifically designed for use by construction and maintenance departments are announced by Homelite. These new units, the 115-volt, 60-cycle Model 8A115 and the 115/230-volt, 60-cycle Model 8A115/230, provide a dependable source of power for operating electric drills, saws, concrete vibrators, floodlights and other power tools. Weighing only 140 lbs., these compact generators can be carried easily to the job and used anywhere on the job. Exclusive generator design eliminates DC brushes, commutator and DC armature windings to reduce maintenance costs to a minimum. Power is provided by a dependable Homelite 2-cycle gasoline engine directly coupled to the armature shaft. For further information write Homelite, Port Chester, N. Y., or circle **No. 5-11** on the reply card.

Blacktop Spreader Attachment Available For Payloader Tractor-Shovels

Spreader can work in close quarters for placing new pavements or patching

The Frank G. Hough Co. has announced a blacktop spreader attachment designed exclusively for models HU, HH and HO Payloader tractor-shovels. Spreader attachment, front-mounted and interchangeable with the bucket, provides an economical unit that lays down hot or cold mix asphalt in strips up to 8-ft. wide in a single pass. Uses include placing new pavement, resurfacing or patching streets, driveways, alleys, sidewalks, playgrounds and parking lots. All spreader operations are hydraulically controlled. Conveniently arranged levers give operator fingertip control of throttle, main feed gate, width adjustment to 8 ft. and thickness of spread up to 6-ins. The capacity of the hopper is 2 cu. yds. Complete information and detailed specifications from The Frank G. Hough Co., 761 Seventh Ave., Libertyville, Ill., or by circling **No. 5-12** on the reply card.



New Venturi on right and old type left

New Type Venturi

The Infilco Twin-Throat Venturi is a completely new Venturi which produces higher differential pressure or lower head loss in a much shorter laying length. Applications include metering of water, sewage, air and other fluids and gases. The low pressure is taken from a hydraulically-streamlined body instead of from a wall. This body is placed in the center of the narrowest cross-section, at a point at which the pressure is further lowered by the locally increased velocities around it. By such an arrangement a higher differential is obtained without materially changing the energy conversion in the tube, while the head loss remains practically the same. It is available in a full range of sizes. Complete information from Infilco Inc., P. O. Box 5033, Tucson, Arizona, or by circling **No. 5-13** on the reply card.

Rotary Cutter for Grass, Weeds and Underbrush

International Harvester has just announced a new heavy-duty McCormick No. 26 rotary cutter that works effectively at fast tractor speeds in heavy growths of grass, weeds and underbrush. It mows a 5-ft. cut and is well adapted for maintaining parks, playgrounds, golf courses, highway shoulders, airfields and other extensive areas requiring constant maintenance. PTO-driven, and intended for use with 25-hp or larger tractors, the unit is available in either fast-hitch or trailing models. The fast-hitch model is raised completely off the ground for turns or transport, as well as adjusted for cutting height by the tractor's Hydra-Touch hydraulic system. Cutting height can be adjusted from three inches to fourteen inches above ground. Safety shields protect the operator from flying debris. Side-mounted skid shoes prevent rotor blades from digging into rough ground, and a shear bolt protects the drive assembly from damage should knives strike an immovable object. A shredding attachment for reducing residue to pulp for quick decomposition is available as special equipment. For full information write Consumer Relations Dept., International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill., or circle **No. 5-14.**

Front End Loader For Utility Type Tractors

A new industrial front-end loader for use with utility type wheel tractors has been announced by A. C. Anderson. The Model E features a system of bucket roll back and parallel linkage of the twin hydraulic lift arms which enables complete bucket filling and allows free roll back under load without pulling away from the bank or dirt pile being moved. The all-mechanical parallel linkage of the loader arms is unique for loaders built for small tractors. It enables the operator to keep the load closer to the tractor and provides more complete use of hydraulic power for both breakaway and carrying loads level. Clearance under the bucket in dumped position is 98 inches and over-all height of the bucket raised totals 138 inches. The Model E is available with any or all of three different buckets. Standard bucket capacity is 1/3-cu. yd. with 49-in. over-all width; large bucket capacity is ½-cu. yd. and 66-ins. over-all width; and a snow bucket capacity of 1-cu. yd. and 66-ins. over-all width. For more details write to A. C. Anderson, Inc., Dept. A-97, P. O. Box 391, Wildwood, N. J., or circle **No. 5-15** on the reply card.

Bucket has free roll back under load

Backhoe digs 12½ ft. deep in any position of a 190° arc

Roadside sprayer has a 1000-gal. tank that sprays 20 gpm

Ottawa Backhoe On Chevrolet Truck

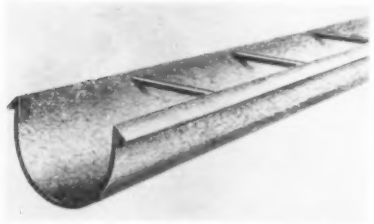
To meet the growing demand for a trench-digging machine to work in one area in the morning and get to work at another jobsite miles away in the afternoon, Ottawa Steel Division has designed a truck-mounted backhoe for Chevrolet ¾-ton trucks and larger. A quick on-and-off feature of the backhoe leaves the truck free for other work when not needed for digging. The new Ottawa truck-mounted backhoe digs 12½ feet deep in any position of its 190° swing. A turret type seat which pivots with the boom is offset so the operator can see without leaning to one side. Seat height is also vision-engineered for top efficiency when digging deep trenches or loading trucks. The power of the Ottawa hydraulic system is converted to 7000 lbs. of digging force. Ejector buckets are available in 14, 18 and 24-in. widths. Standard trench buckets come in 18, 24 and 30-in. widths, and a special grave-bellhole bucket for digging straight sides and square corners that need no hand finishing is available in 18, 24, 30 and 36-in. widths. For complete information write Ottawa Steel Div., Young Spring & Wire Corp., Ottawa, Kans., or circle **No. 5-16** on the reply card.

Highway Sprayer

John Bean Div. has developed a highway sprayer, with a 1000-gallon tank, that delivers up to 20 gallons of spray per minute. The results in using the large-capacity tank are numerous. Stops for water refilling are kept at a minimum thus allowing the operator to spray more miles of roadside from each tank load. The sprayer is powered by an 18-hp two-cylinder, air-cooled engine. The unit is only 60-ins. wide, 48-ins. high and 134-ins. long, and can be mounted on any standard wheel base truck or in the dump body of conventional highway department trucks. The nozzles and spray gun are operated by one man who directs the material to cover the entire roadside. The adjustable gun is hand directed and permits uniform coverage of the roadside at travel speeds from 5 to 10 mph or more. For more information write John Bean Div., Food Machinery & Chemical Corp., Lansing 4, Mich., or circle **No. 5-19** on the reply card.

Plastic Wash Water Trough Introduced By Leopold

A new plastic wash water trough for water filtration plants that offers a number of important advantages has been announced by F. B. Leopold. This unique trough is made of fiberglass-reinforced polyesterlaminate plastic. It is corrosion resistant, light in weight, durable, easy to handle, has a smooth hard surface, and resists all kinds of weather. In addition, it is inexpensive to install, never needs painting, and will last indefinitely. The glass mat is extra heavy to provide added strength, and plastic or stainless steel cross braces are provided for maximum rigidity and strength. Sand stops are an integral part of the trough and the weir edges are mold-formed, thus eliminating the job of field grinding. It can be supplied in a number of cross-sectional dimensions, providing capacities to suit any requirement. For additional information write F. B. Leopold Co., Inc., Zelienople, Pa., or circle **No. 5-17** on the reply card.



Lightweight plastic wash troughs are available for water filtration plants

Digger For Guardrail and Fence Building

J. H. Holan Corp. has come up with a new optional feature for Series 6800 and Series 3700 Power Derricks. Hydraulic lines for the digger run along either side of the derrick leg. This arrangement keeps lines out of the mud and out of the way, and allows the digger to be stowed without disconnecting the hydraulic lines. For more details write J. H. Holan Corp., 4100 West 150th St., Cleveland 11, O., or circle **No. 5-18** on the reply card.

Sanitary Water Cooler

The Schlueter Mfg. Co. is making a hot dipped galvanized, completely sanitary water cooler. All seams are sealed and the cooler is 100 percent rust proof and leak proof. These coolers are also lined with Sparklen plastic. This plastic liner is baked on with infra ray lights for permanency and will keep the interior odor and taste free indefinitely. All models available from 2 to 15-gallon sizes are fully corrugated for greater impact and damage resistance, have solid brass nickle plated spigots, and the insets have rounded bottoms for cleanliness. For more details write The Schlueter Mfg. Co., 4616 N. Broadway, St. Louis 7, Mo., or circle **No. 5-20** on the reply card.

Littleford Portable Asphalt Plant

Littleford has a new portable asphalt plant with a rated capacity of 30 tons per hour. Feature of this unit is a 5-ton dual feeder bin that proportions and feeds aggregate directly into a 30-ton rotating dryer made of heat resistant Cor-Ten steel. An enclosed hot elevator delivers a continuous cascade of aggregate and the 5-ton storage hopper holds and discharges aggregate as required. The plant is simplified, easy to operate, practically automatic, and requires only one operator. For more details write Littleford Bros., Inc., Cincinnati, Ohio, or circle **No. 5-21** on the reply card.

Black-Top Patch Roller

Unit makes a permanent asphalt patch

The Martin Patcher, hydraulically-operated black-top roller for fast easy attachment to any dump truck has been announced by the Martin Co. The simple, self-cleaning, self-contained unit makes patches that stick by using controlled compaction maintained by hydraulic pressure against the weight of the truck. Lower the unit to roll the patch—draw it up under the box to travel. The patcher adds little weight to the vehicle and does not limit road clearance. For more information write the Martin Co., 620 Andrews Avenue, Kewanee, Ill., or circle **No. 5-22** on the reply card.

Self-Sealing Coupling For Steel Water Lines

Speedy, simple and low cost joints on underground steel water lines is now possible with the new Dresser Style 200 "Aquapak" self-sealing coupling. The Style 200 consists of a steel body with a specially designed Dresser Grade 27 gasket. The gasket has three sealing lips which combine with internal water pressure to form the seal. The "Aquapak" is available in a range of OD sizes from 4 to 12¾ ins. The "Aquapak" reaches the user completely factory-assembled. There are no loose parts; the gaskets are assembled in the coupling and need not be removed prior to installation. The couplings also possess "give-and-take" flexibility which permits curves to be laid with straight sections of pipe. For full details write Dresser Mfg. Div., Bradford, Pa., or circle **No. 5-23** on the reply card.

Gaskets are assembled in the coupling

Shawnee Backhoe

Full-cycle speed and a new lifetime factor in the 180° uninterrupted swing are two important features of the Shawnee "88". The double-cylinder swing incorporates a heavy duty chain and sprocket and the cylinders are designed to afford lifetime automatic compensation for any wear in the swing mechanism. Cleanness of design is achieved by gathering hydraulic hoses out of the way and by Shawnee's unique "hidden cylinders." All cylinders are enclosed, with the rods covered and protected. Buckets are available in widths from 16 to 36-ins. They can be changed quickly and without use of tools. The unit in conjunction with the Shawnee line of loaders, is available for all light industrial utility tractors manufactured since 1939, including new makes and models. For full details write to Shawnee Mfg. Co., 1947 N. Topeka, Topeka, Kans., or circle **No. 5-24** on the reply card.

Backhoe fits all industrial tractors

Photocopy Machine

Copy machines are used in offices to eliminate re-typing and proof-reading

A fast photocopy machine has been announced by American Photocopy Equipment Co. Called the Apeco Uni-matic "Auto-Stat," the new one-step copier is used extensively in offices to eliminate re-typing and proof-reading. The unit makes clean, sharp black on white copies of anything from a printed, typed, written, photographed or drawn original. The one-step synchronized operation permits the original copy and photocopy paper to be inserted only once, rather than twice. Weighing approximately 34 pounds, the Auto-Stat is 7 ins. high, 13½ ins. deep and 21 ins. long. Push button controlled, it operates on normal electric current. For more details write American Photocopy Equipment Co., Evanston, Ill., or circle **No. 5-25** on the reply card.

Huber-Warco Adds Features To 3-5 Ton Tandem Roller

The addition of a tail-shaft governor, in connection with the torque converter, permits the operator to maintain a pre-selected rolling speed, regardless of grade, without touching the hand throttle on the Huber-Warco 3-5 ton roller. There is no need to adjust the hand throttle as steeper or lesser grades are encountered. The tail-shaft governor also allows more use of the engine compression as a braking factor on exceptionally steep grades. Another important feature is the addition of a foot operated brake located on the transmission output shaft. Other features include a torque converter, water-cooled engine, spur gear final drive, and dual controls. For complete details write to Huber-Warco Co., 202 N. Greenwood St., Marion, Ohio, or circle **No. 5-26** on the reply card.

Prestressed Concrete Tanks Show Big Savings

Maintenance Costs Cut By 75%

Over a 50 year service life, a prestressed concrete tank will show a 75% saving in total maintenance costs over a steel tank of the same capacity. In today's economy, such a long range saving has tremendous appeal to municipalities and water companies throughout the world. When your tank requirements are in the planning stage, these calculated maintenance costs should be considered. Average yearly maintenance on a 3,000,000 gallon steel tank is estimated at $2500 per year at current prices. For a prestressed concrete tank, maintenance is negligible; however, occasional painting for color effect may be desired.

When the charges for servicing the initial cost plus relative maintenance allowances are plotted, the prestressed

concrete tank will often show a lower out of pocket cost to the owner in less than 5 years. When these costs and their increases are extended for an expected service life of 50 years, the savings to the owner with prestressed concrete are enormous.

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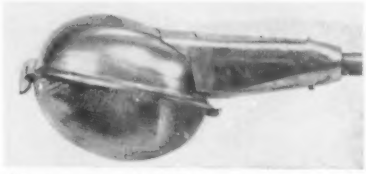
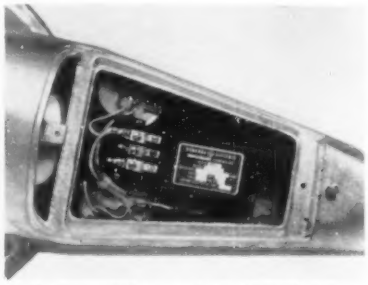
Jefferson Tower Bldg., 351 Jefferson, Dallas, Tex.

Mercury Luminaire With Built-In Ballast



Glass or acrylic refractors are made

General Electric has announced the availability of a 400-watt mercury luminaire with a built-in ballast. The built-in ballast was made possible by the use of an elongated slipfitter which houses the ballast and can be equipped with a special device for mounting a twist-lock photoelectric control. The unit will accommodate 250-watt lamps as well as the 400-watt size. IES Type II, III or IV distribution patterns can be provided with either lamp. Glass or shatterproof acrylic refractors are available with the luminaires.

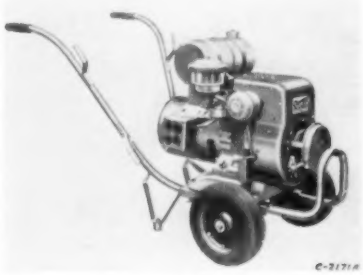


Ballast seated in elongated slipfitter

Whiteways, primary and secondary traffic arteries, highway "danger spots," shopping centers and service areas will provide excellent application opportunities for the new unit. More details from General Electric Co., Schenectady 5, N. Y., or circle **No. 5-27.**

Portable Electric Plant

A new lightweight, portable 1,500 watt direct electric generating plant is introduced by D. W. Onan. This completely self-contained generating plant will provide full-capacity electric power for operating direct current or universal electric tools for turf maintenance, contractors and anybody in general whose equipment necessitates the use of direct current. It is available in three models with carrying frame, dolly-mounted and standard. Its four-cycle, vertical single cylinder, air-cooled Onan Model AK engine, with a rated horsepower of 2.80, is specifically designed for smooth running, heavyduty electric plant operation. For further information write D. W. Onan & Sons Inc., 2515 University Ave., S. E., Minneapolis 14, Minn., or circle **No. 5-28** on the reply card.

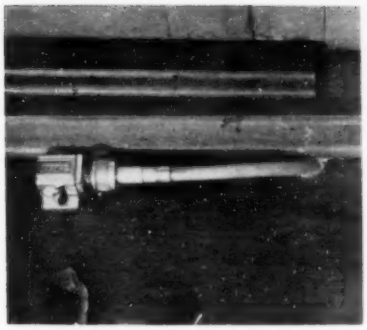


Meter Measures Liquid Flow

Accurate low-cost graphic and visual registration of liquid flow is provided for sewage treatment plants and other installations with the Stevens Recorder, Type B-FT. This recording, indicating and totalizing meter measures liquid flow over Parshall flumes and weirs. The recorder features interchangeable flow cams and flow conversion gears. This is an important economic factor to sewage treatment plants in rapidly growing communities, and in other installations where liquid flow may increase substantially beyond originally anticipated limits. With a simple change of cams and gears, recorder can operate with a different size flume or accommodate a greater range of flow than that for which it was originally purchased. The change does not require factory service. Similarly, change from weekly to daily graphic time scale, or vice versa, is accomplished by merely repositioning one gear. The recorder can be direct float operated or remotely controlled and is available for wall or switchboard mounting, or with cabinet for mounting out-of-doors directly over the float well. Complete information from Leupold & Stevens Instruments, Inc., 4445 N. E. Glisan St., Portland 13, Ore., or circle **No. 5-29** on the reply card.

Outside Water Meter Reading Equipment

The Visi-Meter turns your water meter reading inside-out! The unit is a practical remote recording and indicator system that can assure existing water meter inside protection. It is easily read in one trip by meter readers and eliminates the city's expense and liability of controlling keys to customers' residences. The meter records within

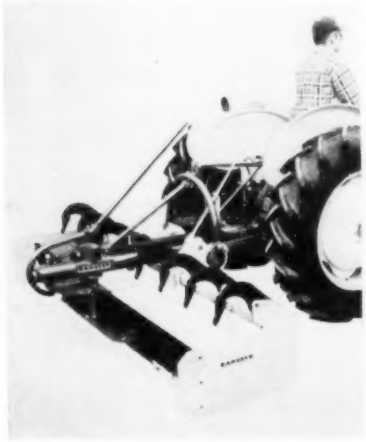


Outside meter is easy to read and records within an accuracy of 0.1 percent

an accuracy of 0.1 percent as required of all water meters, is engineered for minimum up-keep and is protected with tamper proof seals. For more information write Visi-Meter, Inc., 301 North 17th St., Kansas City, Kans., or circle **No. 5-30** on the reply card.

Danuser Scarifier—Scraper Attachment

This multipurpose attachment available from Danuser Machine Co., is easily bolted to the 6 or 8-ft. Danuser blade in a few minutes. The Scarifier-Scraper unit rips, scarifies, scrapes, grades, levels, backfills and terraces any kind of soil, including clay, packed top soil



Multipurpose attachment is operated by one man with the hydraulic controls

or hardpan. One-man operated hydraulic controls raise, lower or hold the unit to the desired working position. A spring-loaded control handle, which is accessible to the tractor seat, lifts the scarifier teeth when not in use. For further data write Danuser Machine Co., Fulton, Mo., or circle **No. 5-31** on the reply card.

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ASST. SUPT. WATER & WASTE TREATMENT PLANT WANTED

We are looking for an energetic man with a capacity to take instruction and direct personnel, and to become assistant superintendent of our water and waste treatment plant. Must be qualified to make chemical analysis and do some research work on waste treatment. Some knowledge of biological organisms and their identification helpful.

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Industrial Water Supply Company
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Opportunity for SANITARY ENGINEER in Rochester, N. Y.

A Sanitary Engineer to supervise the maintenance and operation of Sewage Disposal Plants, Sewer Maintenance work and Incinerators and related work. Applicant must be a college graduate with B.S. degree with a major in Sanitary Engineering plus 10 years experience in the field of Sanitary Engineering, 4 years of which have been in Sewage Plant operation. Applicant must be eligible for a New York State Engineer's license and a New York State Class "A" Sewage Operator's license. Salary range, $8550-$10,350. Apply by letter before June 15, 1958.

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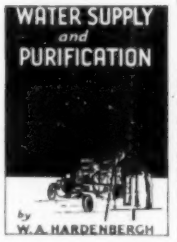

Water Supply and Purification

By W. A. Hardenbergh

Among the major changes introduced in this latest edition are the following: The chapters on ground water, on filtration, and on laying pipe and maintaining lines have been almost completely rewritten; the chapters on pipe conduits and on disinfection have been revised to bring the material in them up-to-date; and a new chapter has been added on fluoridation. Design examples of all kinds are worked out in detail to illustrate practical, up-to-date methods. To order your copy circle A-1 on the coupon.

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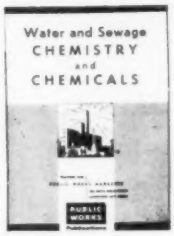
Water and Sewage Chemistry and Chemicals



If you are not an expert chemist but want a dependable text on chemistry as applied to sewerage and water works—send for this valuable reprint today. Written in plain language so anyone can understand it. Four color illustrations are used to show the exact nature of colorimetric reaction in some specific laboratory tests — something that is possible only with this type of work. Of special interest to water or sewage plant operators. To order your copy circle number A-2 on the coupon.

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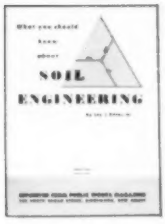

What You Should Know About Soil Engineering

Soil Engineering is the practical application of engineering principles to problems involving the use of soil, either in its natural condition or as a construction material. In this authoritative booklet all phases of soil engineering are treated in simple, easily understandable language. Full information is provided on basic soil properties, classification systems, field and laboratory tests, frost action and compaction. Liberally illustrated and containing many special charts and graphs. To order your copy circle A-3 on the coupon.

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ALGAE of Importance in Water Supply

This major article was prepared in close collaboration with U.S. Public Health service authorities. It includes, for the first time in magazine history, full and accurate color plates for the identification of types of algae most important in water supplies—those which cause taste and odors, clog filters or are likely to be found in clean or polluted waters. Color plates of this quality have never before been available to simplify the job of algae identification. To order your copy circle A-5 on the coupon.

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Sewerage and Sewage Treatment

By W. A. Hardenbergh

An authoritative yet simple treatment of the subject by one of the nation's foremost authorities. Mr. Hardenbergh's editorial and field work has brought him in close contact with the problems that trouble the average engineer and in this book he explains those methods most suitable for general use. Special attention is paid to sewerage systems both storm and sanitary. Design examples of all kinds are worked out in detail to illustrate practical, up-to-date methods. To order your copy circle A-6 on the coupon.

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The Operation of Sewage Treatment Plants

This valuable text has been completely revised, expanded and brought up to date. In it all phases of Sewage Treatment Plant operation are treated in simple, easily understandable language. Among the many subjects covered are: measurement flow; concentration and temperature; sampling sewage for analysis; laboratory determinations; purposes of treatment; operation of grit chambers; operation of screens; trickling filter operation; filter fly control; disposal of sludge; etc. To order your copy circle A-7 on the coupon.

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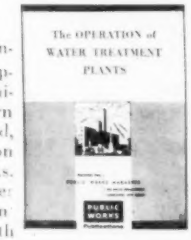
The Operation of Water Treatment Plants



Here in one place you have the basic information concerning all phases of plant operation. Even those without previous technical school education will find it easy to learn from this valuable text. Completely revised, expanded and brought up to date by Clayton H. Billings, Associate Editor of Public Works. This reprint is of special interest to Water Works Superintendents, Water Treatment Plant Operators and everyone connected with the Water Works field. To order your copy circle A-8 on the coupon.

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by Arthur K. Akers

★ K. N. CUNDALL, Manager of Laykold sales and advertising, American Bitumuls and Asphalt Co., San Francisco, becomes president, International Bitumen Emulsions Corporation, a subsidiary of American Bitumuls.

Mr. Cundall

Mr. Appleton

★ HERBERT M. APPLETON is appointed assistant to Vice-President and General Manager, George N. Proctor, at The Permutit Co. Division of Pfaudler Permutit Inc.

★ HYSTER CO., Portland, Oregon acquires Martin Machine Co., Kewanee, Ill., by merger. Distribution everywhere continues through Caterpillar-Hyster dealers.

★ YEOMANS BROTHERS, Melrose Park, Ill., manufacturers of sewage treatment equipment, name Spaulding A. Norris, general sales manager.

★ ROBERT L. SEITZ becomes vice-president and sales manager, American Water Softener Co., Philadelphia.

★ THE EXPANSION JOINT INSTITUTE elects Wallace C. Fischer of Servicised Products Corporation its president. William E. Hagemeister of Presstite-Keystone Engineering Products Co., becomes vice-president of the Institute.

★ WHEN a company as large and important as American Hoist & Derrick Co. of St. Paul announces eight changes in executive personnel in one month we run out of space and can only summarize that men and matters are moving there!

★ SMITH-BLAIR Inc., South San Francisco, open a new assembly plant and regional sales office in Henderson, Texas.

★ LESLIE C. OVERLOCK is new national sales manager of American Photocopy Equipment Co., Chicago.

★ THE UNION METAL MANUFACTURING CO., Canton, Ohio, (lighting standards) appoints L. F. Heckmann, general sales manager.

★ CHAIN BELT CO. elects O. W. Carpenter, president.

★ WAUKESHA MOTOR CO. (Wis.) has purchased the assets and engine business of The LeRoi Division, Westinghouse Air Brake Co., Milwaukee.

★ THE LUDLOW VALVE MANUFACTURING CO. news includes naming of Robert G. Burnside as

Mr. Burnside

Mr. Cummings

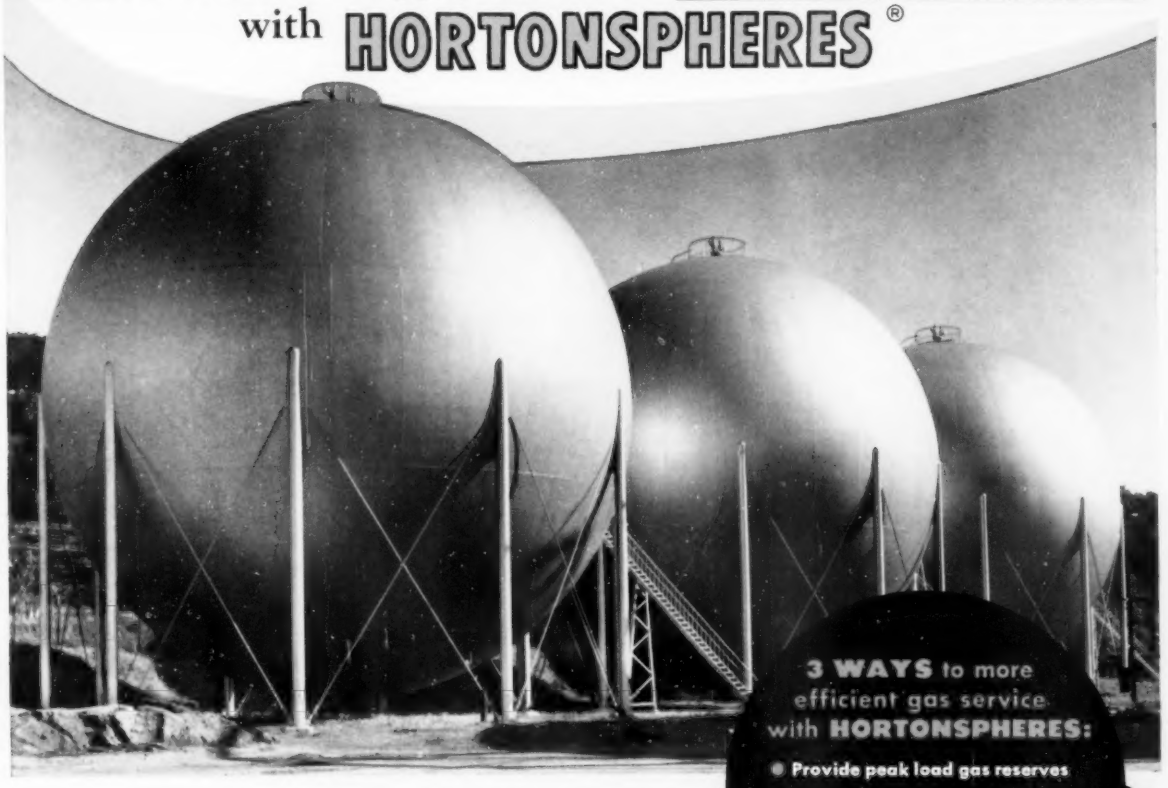
sales manager, to succeed Eric A. Rutledge, retired. Richard A. Cummings is advanced from chief engineer to vice-president, manufacturing, and Fred W. Wemmerus is named chief engineer.

★ HENRY PRATT CO. (Butterfly valves) opens a Western Sales Office in Los Angeles, Robert L. Armstrong in charge.

★ MINNEAPOLIS-MOLINE CO., Minneapolis, promotes Roger R. Hipwell from product manager to manager of advertising and sales promotion; Clem A. Kiener, regional sales manager, Columbus, Ohio, advances to assistant general sales manager, at the Hopkins, Minn., general offices.

★ WHEN you argue with a fool be sure he isn't similarly engaged.

Smooth out Gas Supply Problems Efficiently, Economically with HORTONSPHERES®



3 WAYS to more efficient gas service with **HORTONSPHERES:**

- **Provide peak load gas reserves**
- **Provide ready gas supply at remote points**
- **Meet growing use requirements without expanding plant facilities**

Hortonspheres provide an economical way to increase the capacity of gas distribution systems without the expense of additional production or pipe line facilities. Installed at the plant or in a remote section of the lines, Hortonspheres can be depended upon to maintain pressures throughout the day—or can be used only at peak load periods.

In addition, Hortonspheres require less ground area for a given amount of storage than low pressure storage methods. They have no operating parts and require little attention. They present a pleasing appearance and the smooth, *welded steel* structure is easy to paint and maintain.

The Hortonsphere is *another* example of how CB&I's *craftsmanship in steel* is helping modern communities to meet their growth problems, gracefully . . . at a minimum of cost as compared to the efficiency delivered. Write your nearest CB&I office for further information.

New, tougher steels with higher yield strength and continuing improvements by CB&I in design, testing, fabricating, and erection techniques and equipment have considerably extended the volume of gas that can now be stored at high pressure. Write for details.

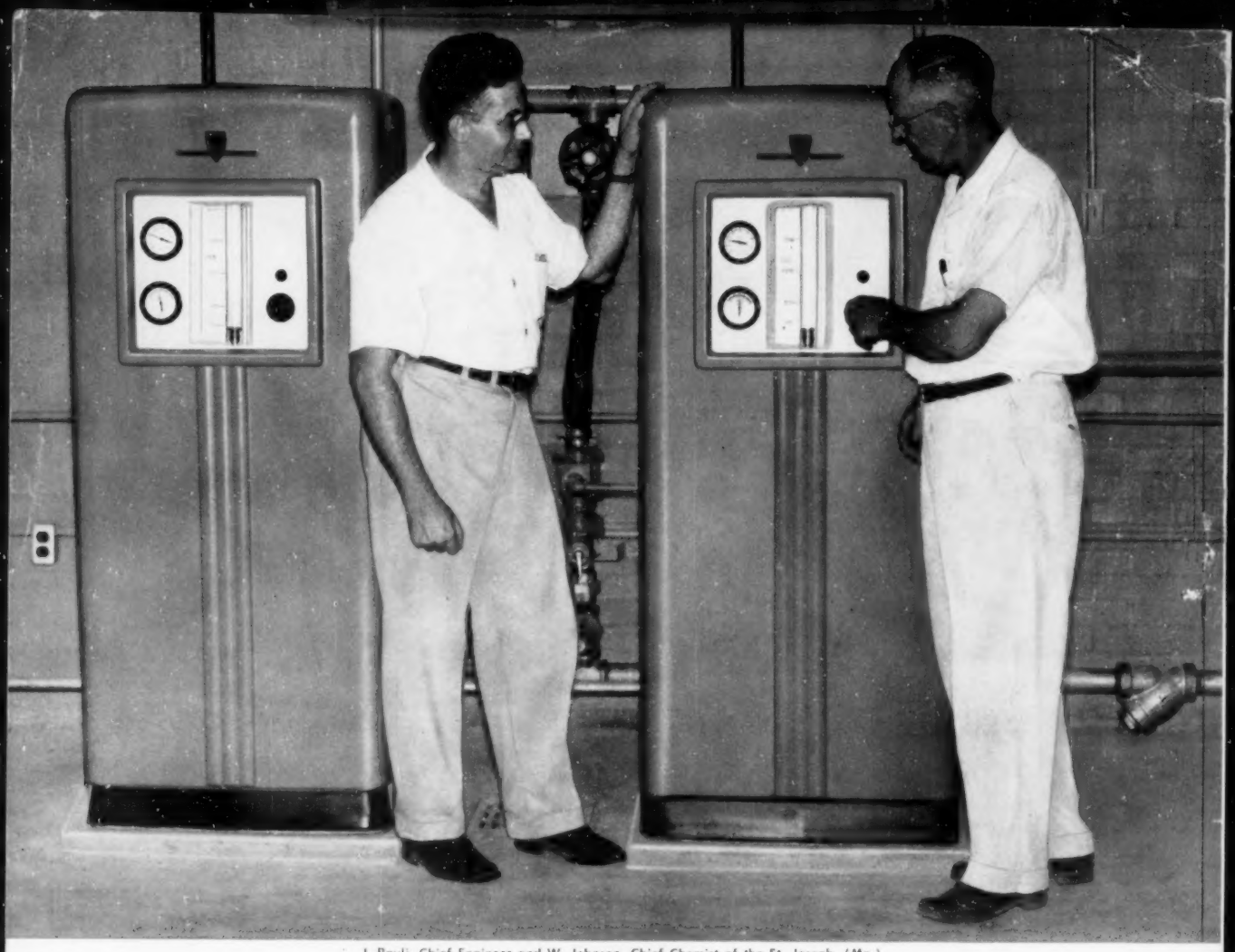
Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston • Kansas City (Mo.)
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, GREENVILLE, PA. and at NEW CASTLE, DELAWARE.
In Canada: HORTON STEEL WORKS LTD., TORONTO, ONTARIO

CB&I

Three 76-ft. diameter Hortonspheres serve growing gas requirements at Meriden, Connecticut for the Connecticut Power and Light Company.

M49C



J. Pauli, Chief Engineer and W. Johnson, Chief Chemist of the St. Joseph, (Mo.) Water Company, discuss operation of their W&T V-notch chlorinators. The St. Joseph Water Co. is part of the American Water Works Service Co., Inc. system.

W&T V-notch Chlorinators— doubly accepted

The St. Joseph Water Co. found breakpoint chlorination the best way to treat Missouri River water. But this increased the range of chlorine requirements in the water treatment. W&T V-notch chlorinators were the answer.

W&T V-notch chlorinators have a chlorine feed range of 20 to 1 with an accuracy of 4%. Based on this acceptance at its St. Joseph plant, the American Water Works Service Co., Inc. has purchased V-notch equipment for use in other plants.

V-notch chlorinators are available to feed from 2½ to 8000 pounds of chlorine per 24 hrs. V-notch equipment also provides permanence and attractiveness through modern reinforced plastics. For comprehensive information about W&T V-notch chlorinators, write for Bulletin S-119.

WALLACE & TIERNAN INCORPORATED

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